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Electrical Cutting of Steel I-Beams and Girders.

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The application of the electric arc to the destructive cutting of metals is readily suggested from the numerous instances of arcing with which everyone is familiar who has to do with the operation of electrical machinery. A few specific instances of the use of the arc in cutting an isolated beam are on record, and some years ago there appeared in the technical press considerable discussion concerning the

GAS ENGINE AND GENERATOR MOUNTED ON WAGON READY FOR USE.

protection necessary to the modern safe in order to be proof against the "electrical burglar."

The presence of thousands of tons of tangled steel in the building ruins of San Francisco seemed to warrant a more thorough investigation of the process than had heretofore been given to it. If the process of cutting the bent and ruined steel could be practically perfected, it seemed to be a solution to the problem of removing the debris of this class.

A number of experiments were, therefore, undertaken in the electrical engineering laboratories of the University of California to determine the possibilities of the use of the electric arc in cutting metal beams. As a result of extensive experiments, an electrode has been evolved which has proved quite successful. Figure 1 is a photograph showing a 15-inch I-beam which was cut in two pieces in 20 minutes. To make the corresponding cut with a hack saw would require several hours. Figure 2 shows an angle iron which was cut in one minute. Rivet heads have been melted off in from 15 to 30 seconds.

For best and most economical results, a current of about 250 amperes at from 90 to 100 volts is required. It would seem that a lower voltage might be employed, thereby reducing the necessary consumption of power. Experience has shown, however, that it is not possible to maintain an electric arc continuously with a lower voltage. During the past few years the contribution to technical literature on the subject of the "Counter Electro Motive Force of the Electric Arc" was found to apply directly to this case. Mrs. Ayrton has shown that the potential drop of the carbon arc is expressed in terms of length of arc and current in amperes by the following equation:

$$\text{Potential drop} = 38.9 \text{ plus } 2\,1 \text{ plus } \frac{11.7 \text{ plus } 10.5\ 1}{\text{amperes}}.$$

This equation shows that about 40 volts is the minimum at which the carbon arc may be maintained. In the present application, several factors combine to make the ideal voltage, which, of course, should be as low as possible, impracticable. A considerable external resistance is needed in the circuit to regulate or maintain the arc constant, so as not, for short intervals of time, to seriously overload the generator. In fact, on starting, the generator would be practically short-circuited if it were not for such external resistances. In addition, it has been found as a result of the experiments that using a high voltage a greater flexibility is obtained in the length of the arc, and the arc is not so easily disrupted by wind or air currents if the arc is maintained with a higher voltage and the necessary external controlling resistance.

The positive side of the arc or circuit is, of course, connected or grounded to the structure of beam to be cut, since about eight-tenths of the electrical energy in the form of heat of the arc is expended on this side. The temperature of the positive terminal is approximately 3500° C., or more than 1000° C. higher than that of the negative side. In addition to the controlling devices mentioned, the circuit necessarily contains a resistance which is used only in starting the arc. This resistance is, of course, of such magnitude that the current with the electrode grounded is well under the setting of the circuit breaker. After the arc has been started, this resistance is short-circuited or cut out.

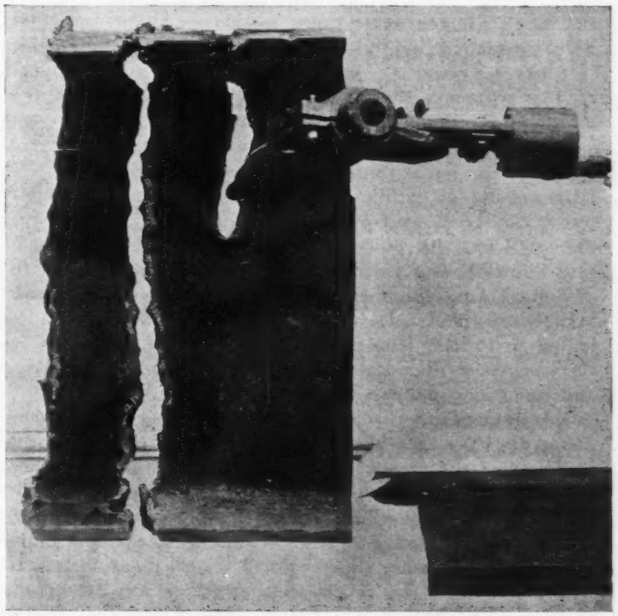


FIG. 1.

Both the resistances above mentioned are made of No. 12 iron wire, wound on wooden frames and immersed in running water. This is the most inexpensive and constant resistance where large currents are involved.

Not only must the operator's eyes be protected from the intense light of the arc, but it is necessary that his hands and face be also protected from the intense heat. Exposure of the skin for only a few minutes to the action of the arc at short range will produce very painful burns. The

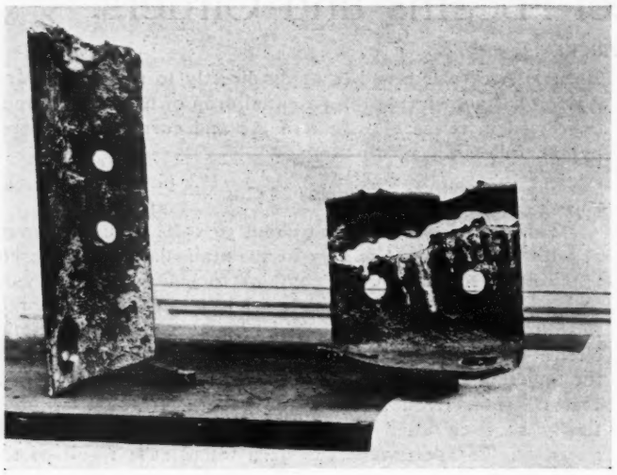


FIG. 2.

hands are easily protected by gloves. The face is best protected by an oilcloth hood, having a rectangular opening in front of the eyes. A mask of oilcloth, having a window of specially prepared glass, covers the opening in the hood when the arc is in use. This protection may be put aside at all times when the arc is not actually at work. With this arrangement, however, during the cutting process the arc may be carefully scrutinized without any injury whatever to the eyes or the skin.

Inasmuch as ample patent protection is now pending in connection with the design and construction of the electrode, this most interesting part of the equipment cannot at this time be fully described.

For practical operation in San Francisco it was found impossible to get direct current at 110 volts. Naturally, it was not advisable to use 220-volt service, on account of the much greater expenditure for power. The 220-volt, 3-wire, grounded neutral system could not be used satisfactorily for two reasons—the first being the unbalancing of the system, and the second, the desirability of using ungrounded circuits entirely.

It was, therefore, necessary to consider either a motor generator set or a portable engine and dynamo plant. The latter, using a gasoline engine, was selected, because of the flexibility of such an equipment, and also on account of the small cost for power. The generating plant consists of a 25-kilowatt, direct-current, 110-volt generator, belted to a 40-horsepower, single-cylinder gas engine, mounted on a 2⅝x12-inch steel axle wagon. The engine and dynamo are bolted to 10-inch I-beams of suitable length, giving 15 feet, the necessary distance between the centers of the engine and generator pulleys.

A four-cylinder, direct-current gas engine would undoubtedly have been preferable, but no such equipment could be found at the present time in the local market, and hence the less desirable machinery was of necessity utilized.

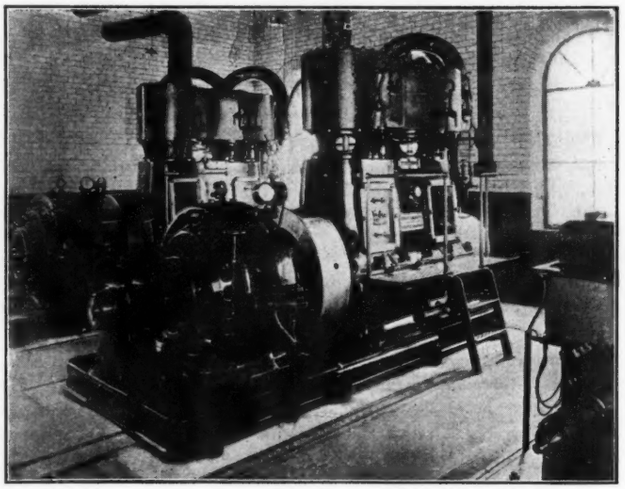
The extent to which this extremely interesting device will be used in San Francisco within the next few months is at the present time undetermined, but in many instances it will undoubtedly be much cheaper than any mechanical method of cutting up the ruined steel frames of buildings preparatory to their removal from the building site.

Electric Power in Coal Mines.

The many advantages of electricity over steam, air and other powers for mine work are such that transmission of power to mines is one of the most important cases in which electrical transmission can be profitably applied. This has been well demonstrated in the power installation recently installed at the Bradford Colliery Company's works, near Manchester, installed complete by Messrs. Holmes & Co., of Newcastle.

In the power house there are four direct connected steam-driven generators, three of which are used for power, and the fourth for surface and underground lighting. The engine sets, together with the motor generator, are mounted on combination bedplates. Three engines are of the self-lubricating, enclosed compound vertical type, the fourth being of the open type. Two of the engines, which have cylinders 14½ inches and 24-inches by 10-inch stroke, are capable of developing 195-brake horsepower each with 90 pounds steam pressure, and will carry an overload of 25 per cent. for two to three hours. They are fitted with special shaft governors and heavy flywheels, and are coupled direct to two Johnson-Lundell six-pole generators, designed for an output of 130 kilowatts each at 525 volts, at 380 revolutions per minute, and for a 25 per cent. overload for two or three hours, with fixed brushes and sparkless commutation.

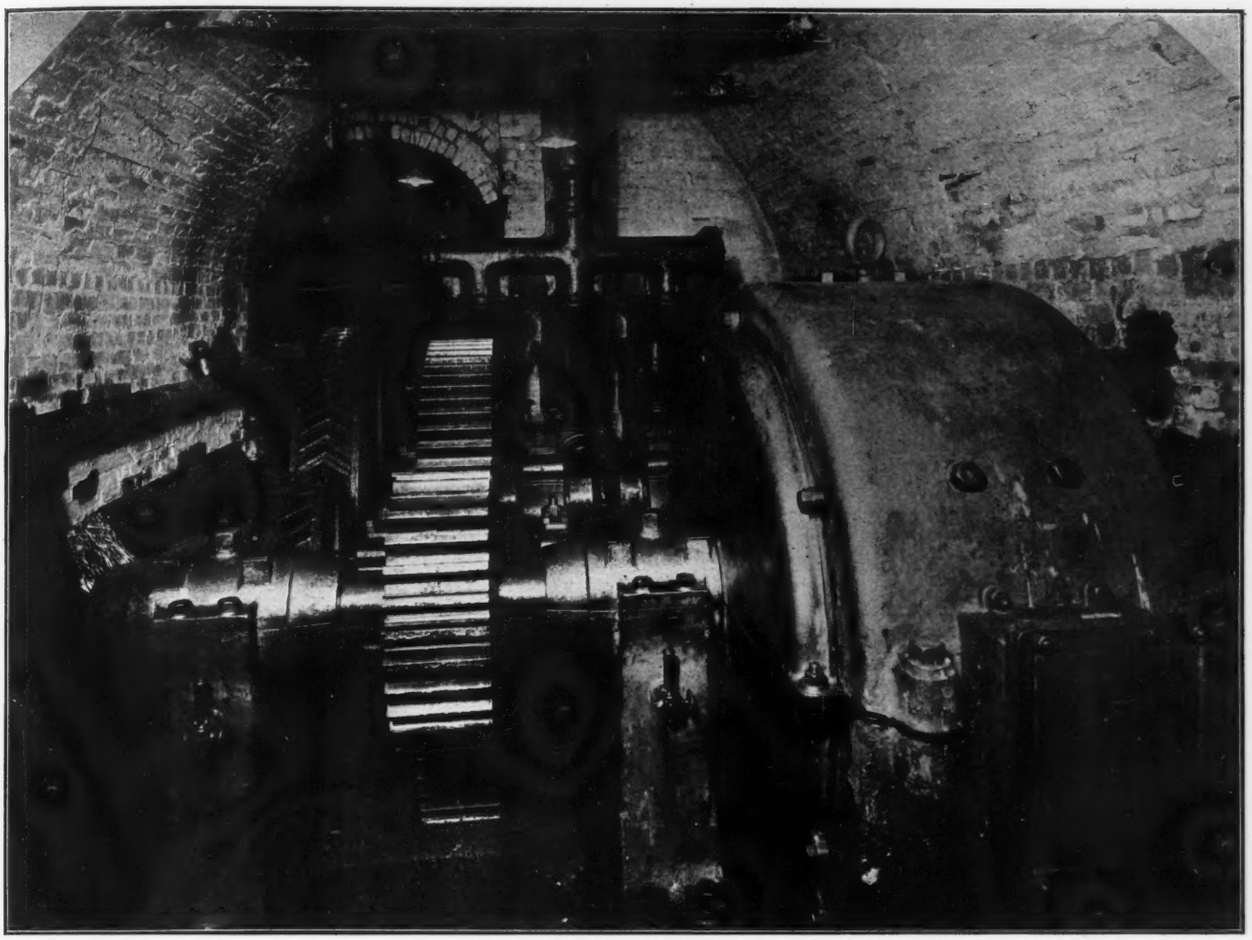
These generators are fitted with split, laminated pole pieces, having an extended pole tip on one side, so proportioned that this half of the magnet core is saturated by the shunt turns alone; as the load increases, the compound winding quickly changes the induction density in the other half of the pole, at which point a strong field is required to obtain sparkless commutation at all loads. With cores of this description, it is possible to employ a much smaller air gap and to deal with greater armature reactions. It has been found possible, in practice, to run these generators for short periods at 100 per cent. overload without altering the brush lead or causing destructive sparking.



ENGINE AND DYNAMO ROOM OF BRADFORD COLLIERY CO.
Showing the Two 180 Kilowatt Sets and the 15 Kilowatt set.

The armatures are slot wound, and the commutators are of ample diameter, composed of hard drawn copper with mica insulation, of such dimensions as to insure adequate capacity to carry the maximum current without excessive heating. The brush holders are carried by split-rings, with an adjusting screw attached to the yoke ring. The bearings are self-adjusting and self-oiling.

The largest dynamo absorbs 500 brake horsepower and gives out 340 kilowatts with a voltage of 525 at 250 revolutions per minute. The engine to which this is directly coupled



LOW DUTY PUMP DRIVEN BY 65 HORSEPOWER "CASTLE" SIX-POLE MOTOR.

is totally enclosed with forced lubrication, and has three cylinders, one high pressure, 24 inches diameter, and two low pressure, 27 inches diameter, with 12-inch stroke. At 90 pounds pressure it runs as a compound engine.

The generator has eight poles of the Johnson-Lundell split-pole type. The armature is 52 inches diameter and 11¼ inches long, with a thoroughly well ventilated core, so that the temperature rise on the six hours' test was only 40 degrees Fahr.

The surface and underground lighting plant consists of a motor generator and a "Castle" two-pole dynamo with drum armature wound with laminated conductors. This latter has an output of 15 kilowatts at 230 volts, 225 revolutions, and is coupled to an open engine having a single cylinder 9½ inches diameter and 9-inch stroke, with automatic expansion governor working at 90 pounds steam pressure.

The motor generator is used to transform the high volts used for power down to the 230 volts necessary for the lamps used on the surface and also underground. The motor absorbs 70 brake horsepower at 525 volts, driving the generator, which has an output of 47 kilowatts at 230 volts, the combination running at 500 revolutions. Both machines are of the "Castle" six-pole type, are of the same size, and designed for running continuously with a low temperature rise. The motor is shunt and the generator compound-wound.

The main switchboard in the engine house is very complete, and is composed of enamelled slate panels with separators between the positive and negative poles.

The main generator panels are fitted with deadbeat ammeters, automatic circuit breakers, patent quick-break chopper switches, and the necessary fuses. Deadbeat voltmeters are located at the top of the board together with a clock, these being mounted in an ornamental pediment.

The dynamo-shunt regulating switches and resistances are so arranged that the resistance coils are coupled direct to the switch contacts at the back of the panels, so that no connecting wires are necessary for joining up the switches to the resistances.

The circuit panels are fitted with double-pole copper switches and fuses, there being a deadbeat ammeter provided for each circuit.

The whole board is mounted in a moulded frame, the total length of the board being about 20 feet.

The switchboards located near the various motors are each provided with an ammeter and an automatic circuit breaker, to insure the current being cut off should there be any accidental short circuit at the motor or an occasional overload.

In practical working these circuit breakers are found extremely useful, as they give the men a good idea as to what load they can put upon the motors. As a general rule, they save the fuses blowing, and it is a much more simple matter to close the circuit breaker than to replace a fuse.

The cables at the pit bottom are so arranged that in the event of one pair of cables breaking down, they would be cut out and the supply taken from one of three sets, until the repairs were made good, thus obviating the risk of a stoppage to any part of the workings.

There are four hauling sets, three for endless rope and one for tail rope. Each of the endless rope sets is driven by a 65 horsepower enclosed "Castle" six-pole motor, compound wound, and designed to run at 300 revolutions per minute on a 500-volt circuit. The armatures are slot wound,

with formed coils, so arranged as to obtain the maximum mechanical strength, combined with the highest electrical efficiency. The motors are fixed to separate bedplates, each having three bearings of ample surface, fitted with ring lubrication and oil gauges. Grooved pulleys, 20 inches in diameter, are used, taking twelve ¾-inch ropes.

The hauling gear constructed for endless rope haulage is mounted on an H-section frame, fitted with angle and knee pieces at the corners, in convenient lengths for taking underground and fitting up, and consists of first-motion shaft driving the winding drum through double helical gearing. The first-motion shaft is fitted with a 6-foot 8-inch diameter split pulley for 12 ¾-inch ropes, and runs at 110 revolutions per minute; from this the power is transmitted by double helical gear to the winding drum. The latter is 4 feet 9 inches in diameter, by 8-inch face, and runs at 16.5 revolutions per minute, and is fitted with cast iron concave laggings which are made detachable; these can be quickly removed and renewed on showing any signs of wear. Attached to the side of the drum is the brake sheave, 5 feet in diameter by 7-inch face; the strap is of steel, fitted with oak blocks. The brake is applied or released by a slow-motion screw fixed to the lever arm. The hand wheel on the screw is fixed near the starting switch, thus enabling the man in charge to start or stop with promptitude. One of the endless-rope gears has an extended bedplate on which is temporarily fixed a tail-rope drum 3 feet diameter and driven by an Ewart's chain from the first motion or rope-driven shaft. This is being used for driving a new brow down hill, during which work the endless-rope drum is put out of gear. On completion of the new brow, the tail-rope drum will be taken off and the endless rope put to work.

The endless hauling ropes are 2300, 1000 and 900 yards long, and can be varied to travel at from one and a half to three miles per hour. To run each rope light takes 22 per cent. of the normal full load. These sets have been running for nearly four years, during which time they have been worked to their maximum capacity without breakdown or stoppage. The starting switches are designed to give slow and steady starting and to permit of running from half to full speed. Each starting switch has two slates. On the short upper slate is fixed a single-pole switch, mechanically closed on the first turn or held on. On stopping or failure of supply, this switch opens, and prevents any damage arising from careless handling by starting the motor with all resistance cut out. To close the switch, all the resistance must be run in, and the operation repeated.

On the lower slate is fitted the bus bar and the resistance section contacts. On the slow-motion screw a crosshead is carried, to which are fixed two sliding connectors or contacts connecting the bus bar with the resistance sections.

The tail-rope hauling set is similar to the larger set, except as regards the drum, and is driven by a 20-horsepower enclosed "Castle" six-pole motor with ropes, pulleys, etc., as previously described.

There are two sets of electrically-driven pumps. The high-duty pump is of the horizontal, treble-ram type, with rams 6 inches in diameter, by 9-inch stroke, and when running at 40 revolutions per minute, delivers 5500 gallons per hour against a head of 1680 feet.

The motor is of the enclosed "Castle" six-pole type, capable of developing 75 horsepower at 350 revolutions per minute at 500 volts.

The power is transmitted through two reductions, the first being 12 ¾-inch ropes, as in the haulage, and the second double helical gear. Owing to the liability of this motor being flooded, it was raised to a higher level, and ropes were substituted for the original spur gearing first reduction, shown in the illustration. Starting and regulating switches and circuit breakers are fixed close to the pumps. The low-duty pump is of the same type, but fitted with rams 8 by 9 inch stroke, and at 44 revolutions per minute delivers 12,000 gallons per hour, against a head of 470 feet.

This pump is driven by a 65-horsepower enclosed "Castle" six-pole motor, running at 300 revolutions per minute, at 500 volts, complete with gearing similar to the above, excepting that the motor is mounted on an extended bedplate, the first reduction being machine-cut steel spur and pinion wheels.

The constructors of the plant have also in hand at present for this colliery a 30-horsepower, 520-volt motor of their "Castle" multipolar totally enclosed type. This motor will be used for driving screens and picking belts.

The New Electrical Works of the Allis-Chalmers Co.

The name Allis-Chalmers, for years well known among power users for excellence of design and workmanship in the construction of steam-driven engines of all kinds, has, within the past few years, come to be more and more associated in the public mind, not only with the production of very large reciprocating steam engines, but also recently with the design and construction of prime movers and power equipment of every description—steam turbines, gas engines, hydraulic turbines and electrical machinery.

The electrical works are located at Norwood, a suburb of Cincinnati, Ohio, and comprise the original model plant

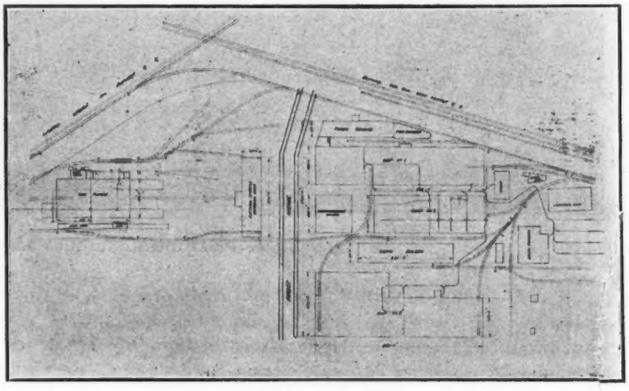


FIG. 1—GROUND PLAN.

of the Bullock Electric Mfg. Co., with extensive additions, which have been and are being made in order to provide adequate facilities to meet the rapidly increasing demand for space. Electrical generating, transforming and driving apparatus of every type is built here, including direct-current dynamos and motors, alternating current generators, induction motors, transformers, rotary converters, railway motors, air-brake motors, controllers, switchboards and a great variety of auxiliary apparatus.

The plat of ground on which the works have been built is approximately 16 acres in area and is situated in close proximity to the tracks of the B. & O. and C. L. & N. Railways, as indicated in Fig. 1, showing the general plan of the works. All of the main buildings are of modern iron, steel and brick or concrete construction, exceedingly well lighted and ventilated. As a group, the buildings of this plant present an appearance which is far above the average, being faced with buff colored pressed brick and designed exteriorily with considerable reference to a pleasing architectural effect. As shown in Fig. 1, all buildings, with the exception of the foundry, face on Forest avenue, and are provided with wide and well-kept grass plots between the pavement and the building proper.

The foundry building, an interior view of which is shown in Fig. 2, is 202 feet long by 103 feet wide. The structure is

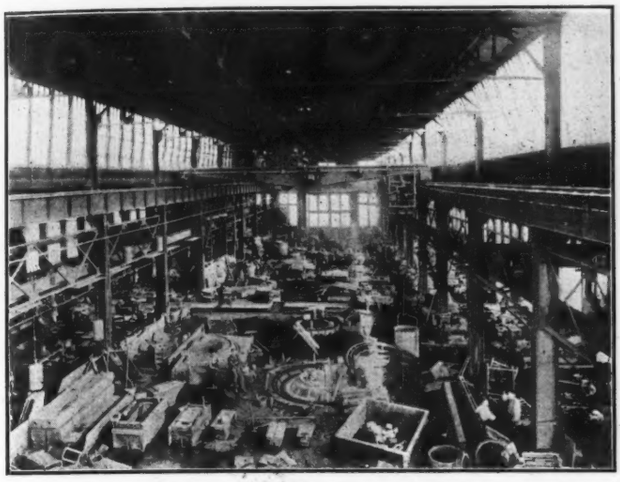


FIG. 2—INTERIOR OF FOUNDRY.

so arranged that it may be readily extended in the rear toward the pattern storage building if a larger capacity is at any time required. The foundry is equipped with two cupolas, with a capacity each of 12 tons per hour. The main bay of the foundry is served by two electric traveling cranes of 25 and 15 tons' capacity, respectively. Each of the side bays is served by a smaller 5-ton crane. Coke-heated core ovens are employed for the treatment of cores and moulds.

The second building, opposite the main buildings and facing them, is the pattern shop and pattern storage, illustrated in Fig. 3. This building is new and of modern construction throughout. It is 53 feet by 216 feet, and four stories in height. The slow-burning mill type of construction has been followed, the floors being of heavy timber with no openings of any description. A tower in the rear of the building contains the elevator, staircase and main electrical wiring, There are no openings from this tower directly into the various floors of the building, but at each landing a fireproof sliding door leads into the main building. The heating system is carried out by means of the hot blast, all the air ducts being built in the walls, thus avoiding the use of galvanized iron pipes. Each floor consists of a single large room, the two upper ones being provided with suitably numbered racks for storing patterns. The storage capacity is approximately 30,000.

The second floor is used as a pattern shop, providing room for 40 pattern-makers. The most approved forms of wood-working machinery comprise the equipment, each tool being driven by an individual electric motor, permitting the most advantageous placing of tools wherever most effective and doing away with all line shafting.

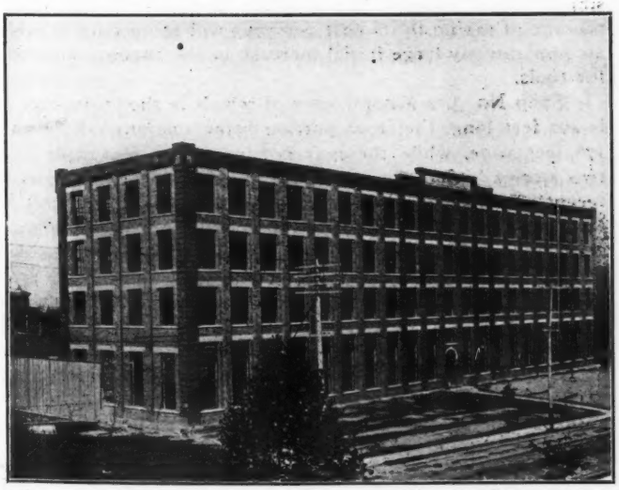


FIG. 3—PATTERN SHOP AND PATTERN STORAGE.

All parts of the building are exceptionally well lighted, as the rooms are comparatively long and narrow, with windows on all sides and with the interior walls coated in white.

The first floor is used as a storage room for small dynamos and motors carried in stock. It is divided into two bays running the entire length of the building and separated by a line of columns which, together with other columns at the side walls, carry the runways for two 5-ton traveling cranes. Freight cars can be run into one end of the building on a depressed track, and material can thus be loaded or unloaded directly.

Machine shop No. 1 of the main group, opposite the pattern building just described, is one of the original Bullock buildings, 102 by 462 feet. The equipment throughout is composed of motor-driven machine tools of all kinds used in the manufacture of electrical apparatus. Several different applications of the motor drive used are shown in Fig. 4. The building is identical in general appearance and construction with the others of the group. The central bay is served by two cranes of 20 and 30 tons' capacity, respectively, and the side bays each by a 5-ton crane. In addition to the machine tool work performed in shop No. 1, a portion of the armature winding for large machines is carried on here, and a testing

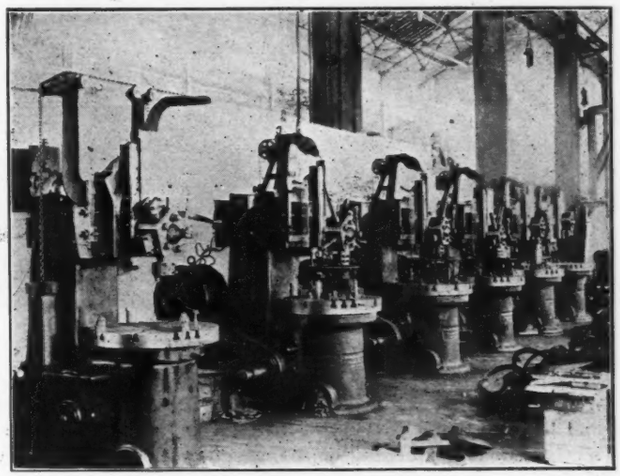


FIG. 4—MOTOR-DRIVEN BORING MILLS IN SHOP NO. 1.

department for the smaller machines has been provided in the front portion of the building. The motors used to drive the machine tools are operated on the multiple voltage system of variable speed control, known as the Ward Leonard three-wire voltage system. By means of this system a speed ratio of 6 to 1 is obtained, giving 12 speeds in the forward direction and 9 in the reverse.

In each machine shop there is a separate balancer installed for splitting the voltages and which may be used independently in case of the failure of those installed in either of the other shops. The connections of these balancers are such that one set may be made to carry the load of the others.

Machine shop No. 2 is identical in general appearance with the other buildings of the group. It is 100 by 303 feet, and two stories in height. The roof has a wide skylight area, which secures a flood of diffused light to the interior of the building. This unit, with the others of the group, is also heated by means of the overload blower system, which draws in fresh air, and having passed it around steam-heated pipes, blows it out through the tubes. This same system keeps the shop at an even and agreeable temperature in Summer by the circulation of cooled air.

A five-ton electric traveling crane serves the entire length of the shop. An industrial railway connects the punch

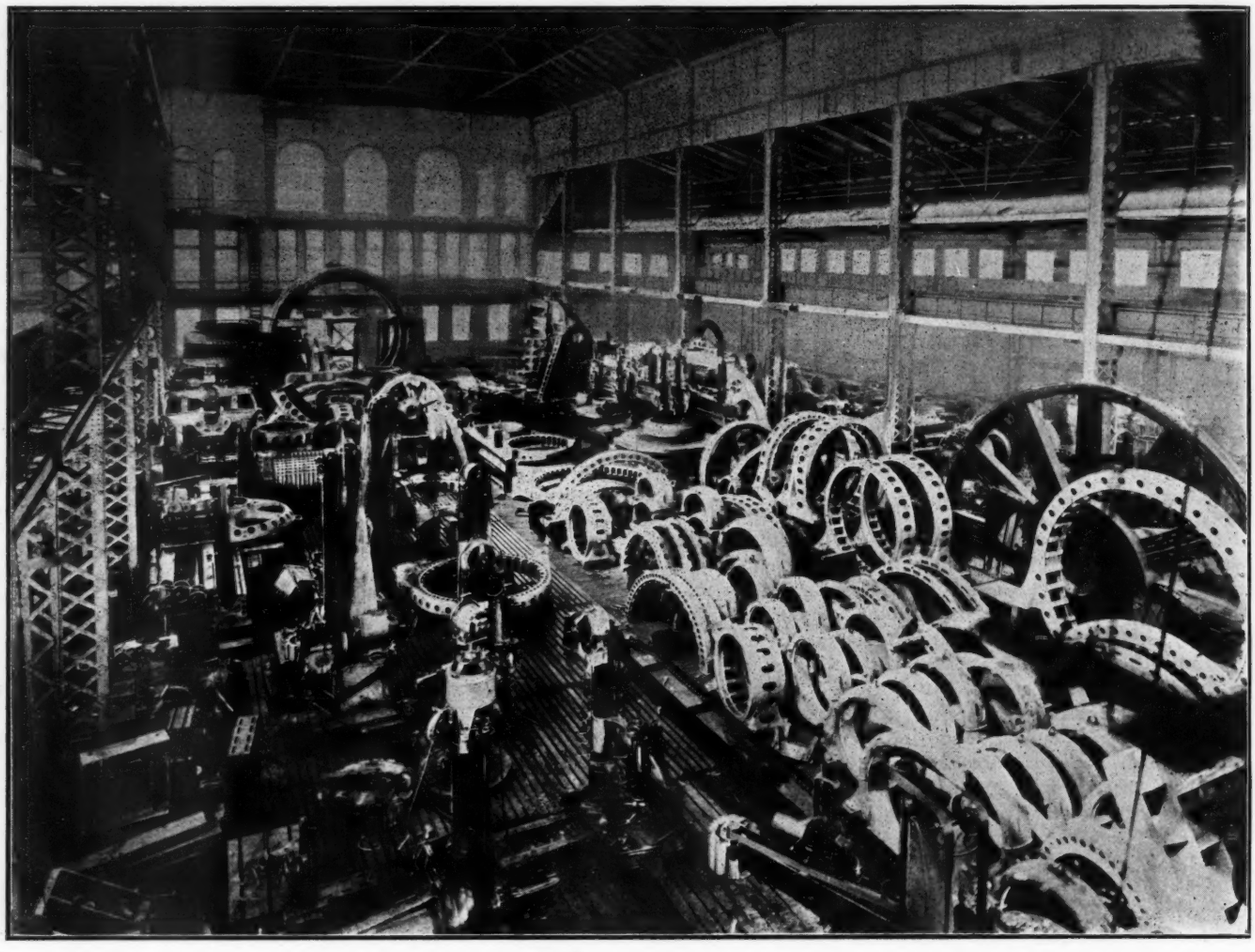


FIG. 5—VIEW IN INTERIOR OF SHOP NO. 3.

department with the annealing. At both ends of the shop freight elevators, driven by electric motors, connect the upper and lower floors. The drying ovens are also connected directly with the insulating department by means of a smaller elevator.

On the first floor is located the punching department, where the sheet steel punchings for armatures and field poles are made. This shop is provided with a complete equipment of motor-driven punch presses. On this floor the armature cores for direct-current dynamos and motors, and the stator cores for small alternating-current machines are assembled. The commutator department is located at the rear, and in a room separated from the remainder of the building by fireproof walls, the punchings for armature and stator cores are annealed and japanned.

The annealing equipment consists of two ovens arranged for oil fuel, each oven with a capacity of about 30,000 pounds of steel at each charging. These ovens are of latest design, provided with recording pyrometers and arranged so that the heat is under complete control at all times. The upper floor of shop No. 2 contains the coil-winding department where armature, field and transformer coils are wound and insulated.

In this shop, every machine tool, from the ponderous drill presses, making laminations for turbo-generators, to the small tapping machines for insulating armature coils, is driven by an individual electric motor The initial cost of many of the smaller tools is somewhat increased by driving each separately; but by this arrangement the machines are rendered independent of each other, so that an accident to one does not interfere with the operation of the other. The system becomes also extremely flexible. Not only can the tools be moved to the work, when it is desirable to do so, but they can be shifted easily from one portion of the shop to another without disarrangement of the power connections. Other advantages are clear headroom, better light, freedom from dirt, economy of operation (as power is only used when the machines are working) and reduction of the liability of accidents to employees. The greatest advantage to be derived from this individual drive, however, is the increased output, due to the fact that the machines can be run at the proper speeds to suit the work. As labor is the greatest single item of expense in a machine shop, a very small percentage of saving in its cost per year will more than balance a comparatively large initial increase in the expense incurred for tools.

Shop No. 3, a general view of which is shown in Fig. 5, is 462 feet long, the front portion being one story high and 176 feet wide, while the rear portion is 107 feet wide and two stories high. The two-story extension in the rear is a recent addition; it is of ferro-concrete construction and is faced with brick on the outside to match the other buildings. Both upper and lower floors are divided into bays by rows of columns, and on the lower floor two 10-ton cranes are provided; the work on the upper floor being of a lighter character, two 5-ton cranes are installed. An elevator is located at about the middle of the extension. On the second floor are the tool room and brass department for the manufacture of small brass parts entering into the construction of machines. The front portion of this unit is used for the construction of large machines and is divided into three bays. The central bay is 68 feet wide and 60 feet high under the roof trusses, and is equipped with a 60-ton traveling crane having a 50-foot lift. Each side bay is 48 feet wide, one served by

a 20-ton crane and the other by one of 30 tons' capacity. Part of the central bay is provided with iron floor platens for the use of portable drills, slotters, etc. Fig. 10 shows a few of the portable tools installed here, equipped with motor drive.

The works power house and boiler plant are located alongside of shop No. 1. The power house equipment consists of two 800-kilowatt, 240-volt direct-connected, engine-type generators, one of which is driven by a Lane & Bodley engine, and the other by a Reynolds cross-compound Corliss engine. There is further equipment consisting of a small 100-kilowatt unit and an air compressor outfit used for operating

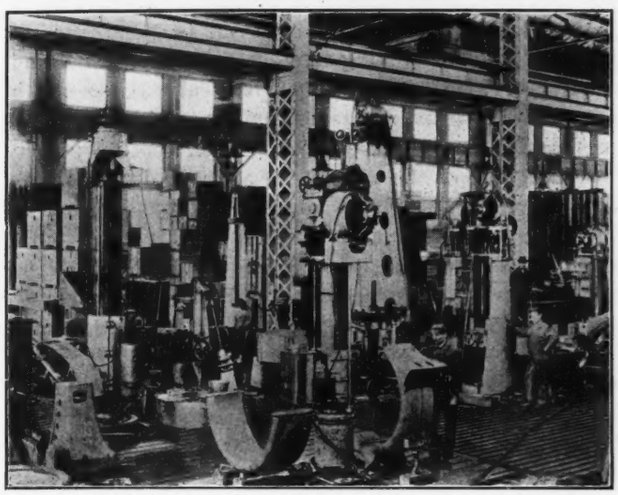


FIG. 6—VIEW IN SHOP NO. 3, SHOWING APPLICATION OF MOTORS TO PORTABLE TOOLS.

pneumatic tools used in various operations throughout the shops. Two artesian wells furnish the entire water supply for engines and fire service. A water storage reservoir is provided for use in fire, with a fire pump in connection with a complete sprinkler system for all buildings. The engines are run non-condensing. The boiler house equipment is comprised in six 250 horsepower Cahall vertical water tube boilers, fitted with Mansfield chain grate stokers.

The service building, 53 feet by 261 feet, is located between shops Nos. 2 and 3. A wire storage room and locker and wash rooms for employes occupy its lower floor. The upper floor is fitted up as a dining room for factory and office employes.

The administration building is 100 feet by 100 feet, and two stories in height. It provides accommodation for the various administrative offices and departments, drafting room, engineering department, purchasing department, superintendent's office, etc.

The general plan of buildings and grounds shown in Fig. 1 gives the layout of standard gauge railroad tracks in yards and buildings. In addition, there is a complete equipment of narrow gauge industrial railway interconnecting the various shop units. All the yard track is equipped with overhead trolley, and motor driven cars equipped with electrically operated jib cranes are used for loading and unloading material and conveying it between the shop buildings.

A UNIQUE BID.

A unique bid for sewer construction is said to have been received by the City Council of Douglas, Alaska. According to the Douglas "News" it read verbatim as follows: "The cost of metiril we no. There is stumps in the way we no. And there is bolders in the way we don't no. There is quick sand that will run we no. There is hard pan that is hard I no. Any one that will take it fer less than 35 cts. a foot will go in the hole I no."—"American Machinist."

A MODERN ISOLATED POWER PLANT.

In these days of modern power-station practice it is not unusual to find, in addition to the great public service corporations, whose heating, lighting and power utilities serve whole municipalities, here and there a private power plant as thoroughly equipped, on a much less extended scale, for the accommodation of a smaller community. This condition is most frequently fulfilled in the case of the great modern office buildings, which stand practically as units, completely outfitted for service of every available description which will procure comfort and convenience.

An isolated plant typical of this class is comprised in the Allis-Chalmers steam and electrical equipment recently installed by the Wells Building Company, of Milwaukee, in the new Stephenson building recently erected by it in the center of the Milwaukee East Side retail district. This building is the second of the kind which has been erected by the Wells Building Company within a comparatively short time, the first one being the handsome 15-story office building erected some three years ago on the old Milwaukee post-office site, corner of Wisconsin and Milwaukee streets. The Stephenson building as originally planned was to be 15 stories high also, but owing to subsequent changes in plans, this structure, which is connected by a service tunnel with the Wells building, only one square away, has been completed for the present to the fourth story only. The structure is built of gray pressed brick, with foundations that rest on bedrock some 40 feet below the surface.

The power plant, which occupies an entire floor of the basement, consists of engine and boiler rooms, where the equipment of engines and generators is erected on rigid rock foundation. The entire layout as originally specified, will comprise six Allis-Chalmers engines and generators, direct connected, having an aggregate capacity of 3000 kilowatts, with a corresponding equipment of boilers, pumps, etc. At the present time the first unit, consisting of a vertical cross-compound engine, direct connected to a 500-kilowatt direct-current generator, is already installed and ready for service, while a unit similar to it in all respects will be ready for operation some time during the summer. The other units provided for in the original plant are to follow later as they are required. The boilers already installed are two Aultman-Taylor Company's Cahall type, provided with the McKenzie Furnace Company's Dutch ovens, each 500 horsepower. As fast as new engine and generator units are installed it is the intention to add similar boiler units for each.

The engines will run non-condensing at a speed of 100 R. P. M. The generator in each case is mounted on the engine shaft between the bearings. Each engine will develop 700 I. horsepower, with a consumption of not to exceed 20 pounds of dry steam per indicated horsepower per hour. Two eccentrics are provided for each cylinder, one for the steam and one for the exhaust valves. Safety stop valves are provided, placed in the main steam pipes next to the throttle, and under the control of a separate governor so arranged as to trip the safety stop-valve and shut off the steam in case the engine runs faster than a fixed limit above normal speed. The generators are engine-type machines, 500-kilowatt capacity at 250 volts.

This plant will be operated in parallel with the power plant of the Wells building for furnishing light, power and heat used in the two buildings. The heating is accomplished through exhaust steam from the engines exclusively. The plant of the older buildings, in conjunction with which the new units will be used, was installed three years ago in the basement of the first building and consists of three engines, coupled to direct current generators, these units having an aggregate normal capacity of 800 kilowatts.

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EDITORIAL.

THE ELECTRIC ARC AS A CUTTING TOOL FOR STEEL AND IRON

The many applications of electricity to take the place of older methods of accomplishing the same result have become so numerous as to excite but ordinary interest. Usually it is the necessity which develops a novel or new method of doing any particular piece of work.

The large amount of money and labor required to clear away the debris in the burned district of San Francisco is surely an incentive to the thinking engineer, to the end that the cost may be reduced and the amount of time required to do the work reduced to a minimum. Undoubtedly, one of the most expensive details is connected with the clearing away of the twisted and bent steel girders, columns and beams, which were in many of the Class C buildings.

In some cases where these beams are but loosely hanging from the remnants of brick walls at an elevation of from three to seven stories, it is a question whether the hazard to the workmen would not prohibit the use of the ordinary means of cutting the beams in two. In addition, the jar involved in the use of a sledge-hammer and coal chisel, which method of operation would require at least two men, might loosen the supporting piece, resulting in the falling of a small or even large part of the wrecked structure.

The proposed use of the electric arc as a cutting tool, and the experiments which have been made up to the present time, would indicate that its field of application should be rather extensive, particularly in the present instance in San Francisco. It may be definitely stated, however, that the cutting of such beams must be of a destructive character rather than that required in the ordinary shaping and sizing of beams and girders in factories for general construction work.

The electrode undoubtedly is the most important detail connected with the system. The principle involved is naturally old, but a thoroughly satisfactory electrode, from the workman's standpoint, must be developed before the plan will find extensive application.

The use of the direct current is of decided advantage. The positive pole of the arc, being the attacked point of the beam or girder to be cut, results in a much higher temperature with the same expenditure of power. The alternating current arc might be found satisfactory, but the direct current arc is so much easier controlled, that its use will probably be found preferable, even at a somewhat greater cost for power.

The cost of the use of the arc will determine its success or failure. If 25 kilowatts or 250 amperes at 100 volts will satisfactorily and expeditiously fulfill the requirements, the cost per hour should not exceed at the rate of 3 cents per kilowatt hour, 75 cents, or $6 for the entire working day, assuming, of course, that the arc would be in continuous operation. With the present price of labor in San Francisco, if the system should not prove too cumbersome, it is evident that the cost of operation, or rather cost of power, would not prevent its extensive use.

The fact that only one man is required at the point of the application of the arc, and that in many cases he, and the apparatus which it is necessary for him to use, may be supported by a swing or derrick, independent of the building structure, should be a factor of importance. The necessary leads can readily be brought to the arc, and when compared even with the pneumatic tool, the device should not be more difficult to handle.

If a large amount of such work were to be done in a given locality, the use of direct current from the mains of the particular company furnishing electric light and power to the district would undoubtedly be preferable. The portable engine and dynamo generating set, which has been hurriedly gotten together, will serve to give the device a good commercial test. If the advantages are found to be sufficient, the scheme will undoubtedly find a field of application much broader than that which seems.

If, after a thorough trial, the method is found to be more economical than doing the work by hand, there seems no reason why it should not be used to very great advantage, particularly during the coming year in San Francisco.

THE OCEAN SHORE RAILWAY.

While it is possible that the disaster of April 18th will for a very short time delay the completion of the partially constructed eighty-three mile double-track, high-speed electric road between San Francisco and Santa Cruz, there can be no doubt that the Ocean Shore Railway will be completed and in operation within a comparatively short time. The scenic attractions of this road will be with-

out parallel, and the fact that it runs for seventy-five miles within sight of the Pacific Ocean along a most picturesque coast is sure to stimulate a large amount of pleasure riding. The road is in many respects extremely unique, and if it were running at the present day would undoubtedly serve a most useful and desirable purpose in connection with the delivery of freight into the center of the city, as well as a means of transportation for San Francisco men to their homes, which would be along the line of the road, between San Francisco and Half Moon Bay or the proposed new town of Balboa.

The new road will open up what is practically the only remaining suburban outlet for those who do business in San Francisco. At the present time a great many of San Francisco business men live in Oakland, Berkeley, Alameda, or Sausalito and other suburban towns in Marin County. The length of time necessary to make the trip across the bay is such as to make a home along the line of the Ocean Shore road south of San Francisco particularly desirable. The running time between the city and the present undeveloped beautiful country along the ocean to the south of the city would not be as great as is now required to cross the bay. The wisdom of the double-track construction cannot be questioned. This alone will guarantee the most satisfactory suburban and interurban service.

Those interested in the project are all well-known San Francisco men. Without a single exception they have made a success of every enterprise with which they have been identified. The way in which they went ahead with the enterprise immediately after the disaster, which would have discouraged almost any other type of man than these loyal Californians, insures the early completion of the road and its thorough and complete construction and equipment.

SERMON BY TELEPHONE.

The Rev. George C. Houghton, pastor of The Little Church Around the Corner, in West Twenty-ninth street, New York, is determined that all in his church shall be able to hear his sermons. Hence he has installed aurophones in the pews.

Hanging to hooks on the backs of the pews are small receivers, which can be concealed in the palm of the hand. They are connected by hidden wires with a transmitter in the pulpit, and catch every word the clergyman utters even to his low tones. Those who have heretofore had difficulty in catching the sermon are able with ease to hear by using the instruments.

ELECTRICITY AND MOSQUITOES.

In his youth, Edison made short work of cockroaches in his telegraph office by electrocuting them, with a "short" of their own. A special cable dispatch from Paris, of July 14, says: "M. Maurice Chaulin has declared war electrically on mosquitoes and gnats. A cylindrical lantern is constructed of two rings suspended one above the other and connected by parallel and vertical chains. These are connected with the source of electricity in such a fashion that each of the chains is always alive. In the center is a lamp. Electric or other light attracts mosquitoes, which begin to buzz around the lamp and come into contact with the chains. The moment an insect touches two at once with its legs it establishes a short circuit and is immedately electrocuted."

Trade Catalogues.

The General Electric Company, Bulletin No. 4442, is devoted to their type GE-87 railway motor. This motor embodies the latest improvements in direct-current railway motor design as adopted by the General Electric Company. The data and curves of the bulletin are particularly valuable, as they show the relation between the tractive effort, speed and efficiency, for this motor, the diameter of the driving wheels being 33 inches, and the gear ratio varying from 4.44 down to 2.78. Both double motor and four-motor equipments may be used, and also with the ordinary controllers or with the Sprague General Electric multiple control.

In a recent bulletin the Kelman high-voltage switches and circuit breakers, manufactured by J. N. Kelman, of 125 S. Thomas street, Los Angeles, are fully described. These switches have been in use for more than three years on high-voltage systems of from 15,000 to 60,000 volts, and have been constantly improved so that now a most satisfactory device has been perfected for all kinds of switching at very high voltages.

"The Economical Lighting of Industrial Plants" is the title of a beautifully illustrated book issued by the Cooper-Hewitt Lamp Co. The advantages of the illumination given by this type of lamp for offices, drafting rooms, machine shops and factories are being recognized very rapidly. Their San Francisco office is at 1002 Haight street, and is but one of thirteen branch offices, in addition to the general office and factory, Pittsburg, Pa.

The August number of the "Monthly Bulletin," published by the Ohio Brass Co., contains, among other articles, an excellent description of the "all wire rail bond" manufactured by this Company. The fact that this bond is contructed of stranded cable without welded or cast joints between the terminals, makes it particularly flexible.

The August bulletin of the Portland General Electric Co. is given over to a description of many pleasure resorts in and around Portland. Illustrations are also given of various buildings in Portland receiving service from the Portland General Electric Co., including the Concordia Club.

Bulletin No. 131 of the Atlas Engine Works, of Indianapolis, contains a complete description of the Atlas single-valve engines, equipped with both throttling and automatic governors. These engines are numbered in sizes from 20 to 1,000 horsepower, both simple and compound.

"Graphite," for August, published by the Jos. Dixon Crucible Co., Jersey City, N. J., is devoted to the interests of the graphite products of this company. The lubricating qualities of graphite are well known and are becoming more and more used as engineers learn from experience of their value.

The Nernst Lamp Co., of Pittsburg, have issued a circular descriptive of the use of the Nernst series, alternating vertical glower street lighting system. The constant current regulating transformers are quite similar to those in use for the ordinary series, carbon alternating current lamps. The character of illumination of the Nernst lamp is particularly satisfactory for street lighting purposes.

General Electric Bulletin No. 4446 is devoted to the detailed description of the starting compensators for alternating current motors built by this company. The details of the wiring are given for the different types of compensators for both induction and synchronous motors.

The Benicia Iron Works are back in San Francisco and are permanently located in the Monadnock Building. They are fully prepared to fill orders, and inasmuch as their works were not in the least damaged, are fully prepared to execute work in the shortest possible time.

PROGRAMME.

Officers 1905-06.

Jno. Martin ..... President
C. O. G. Miller ..... Vice-President
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Geo. S. Colquhoun ..... Wrinkles
R. P. Valentine ..... Experiences
Geo. H. Hollidge ..... Novelties
Geo. P. Low ..... Historian

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COMMITTEES.

COMMITTEE ON GAS ENGINEERS' DEGREE.

L. P. Lowe, E. C. Jones, John A. Britton.

COMMITTEE ON PERMANENT HOME.

L. P. Lowe, C. O. G. Miller, Henry C. Keyes.

ADVISORY BOARD.

R. C. Jones, C. O. G. Miller, John A. Britton.

Morning Session ..... 10 a. m. to 12:30 p. m.
Afternoon Session ..... 1:30 p. m. to 5 p. m.

ORDER OF BUSINESS.

September 18th, 1906.

1 Roll call
2 Reading minutes of last session.
3 Communications.
4 Report of Secretary and Treasurer.
5 Report of Directors.
6 Report of Special Committees.
7 Report of Library Committee.
8 Balloting on applications for membership.
9 Appointment of Committees.
10 Miscellaneous business.

After above order of business, papers will be read as per list following, but not necessarily in the order in which they are printed:

LIST OF PAPERS TO BE READ.

President's Address.

1 Should Gas Companies Engage in the Sale of Gas Appliances? ..... W. B. Cline
2 Best Method of Promoting Gas Sales .... S. P. Hamilton
3 Experiments with Lampblack in Water Gas Generators ..... Geo. S. Colquhoun
4 How the San Francisco Gas & Electric Company Supplied 40,000 Consumers After the Fire..... ..... S. L. Naphtaly
5 How Electricity was Served to Consumers and Street Car Lines by the San Francisco Gas & Electric Company After the Fire..... L. E. Reynolds
6 Personal Experiences with Municipal Gas Plant.... ..... D. O. Druffel
7 The Equity of Sliding Scale Gas Rate..... E. C. Jones
8 Experiences with High Pressure Gas Mains..... ..... Sherwood Grover
9 Utilization of Gas Engines for Power Purposes.... ..... E. C. Lufkin
10 Subject to be announced..... James Goodwin
11 Some Practical Data on High Pressure Gas Compression and Transmission..... E. A. Rix
12 The Art of Canvassing..... John Clements
13 Novelty Editor..... G. H. Hollidge
14 Wrinkle Editor..... Geo. S. Colquhoun
15 Experience Editor..... R. P. Valentine
16 Historian..... Geo. P. Low

Upon completion of reading of papers the following will be the order of business:

1 Report of Committees.
2 Election of Officers.
3 Unfinished Business.
4 New Business.

Wednesday, September 19th,
Banquet.

Thursday, September 20th,
Outing.

AN OPEN LETTER TO THE MEMBERS OF THE PACIFIC COAST GAS ASSOCIATION.

San Francisco, August 6th, '06.

To the Members of the
Pacific Coast Gas Association.

Greeting:

Our annual meeting will be held in San Francisco on September 18th, 19th, 20th, 1906, and a number of very interesting papers will be the subject of investigation and discussion.

It very seldom falls to the lot of the gas fraternity to be able to recount the extraordinary conditions experienced by our brethren in San Francisco and the surrounding territory during the past few months, and I am satisfied that the meeting which we are to hold will become historic and the testimony there given, as to ways and means to overcome unusual difficulties, will prove materially interesting and extremely valuable to the entire fraternity for years to come.

It therefore behooves you to make no other engagements in conflict with this meeting, so that by your attendance you will add strength to the institution of which you are a member, and add materially to your store of wealth in the knowledge you will acquire by contact with those who have had the good fortune and the opportunity to show to the world at large what the gas fraternity can accomplish when called upon in any and all emergencies.

It is hoped that one of the large gas engines will be in operation so that a visit to the plant will be permitted for the education and edification of all the members.

A suitable outing will be held and a most delightful time will be experienced by all who attend. The spirit of '49, coupled with the extreme energy of '06 pervades San Francisco so thoroughly that each and every one of you may come and feel assured of a very profitable meeting.

Not the least of our good purposes in life is to renew old friendships, and this will be done with more hearty handshakes than ever before.

The Secretary will make the usual announcements from time to time.

Let us resolve to make this meeting the largest and best in the history of the association, and we can all do this by agreeing with ourselves to be in attendance, and I certainly expect this of you. Very truly yours,

JNO. MARTIN, President.

PACIFIC COAST GAS ASSOCIATION.

San Francisco, Calif., July 16, '06.

To the Members of the
Pacific Coast Gas Association,

Gentlemen:—Although somewhat disfigured, San Francisco is still in the ring, and, Phoenix-like, has already risen from its ashes, so that the size of the bird is plainly discernible.

We have still left a few choice meeting places for conventions, and the Fourteenth Annual Meeting will be held, as per last adjournment, in the City and County of San Francisco, on Tuesday, Wednesday and Thursday, September 18th, 19th and 20th, 1906.

You need not be reminded of the fact that Jno. Martin is the President, to be assured that the program for the next session will outshine in brilliancy that of any of the past. Good papers on live topics will be furnished, the usual banquet and outing will take place, and it is anticipated that the attendance will far excel that of any previous year.

Due notice of papers to be read, and those appointed to discuss them will be given you. It is advisable that you notify this office immediately upon receipt of this of your intention to be present, in order that accommodations may be reserved for you. Do not forget the "Wrinkle" and "Experience" editors. While their notebooks may be full of the idiosyncrasies of earthquakes and fire, there is still room for a few more "batches" for those of you who are without the belt of shaking Mother Earth.

I am, as I hope you all are, for Greater San Francisco.

JOHN A. BRITTON,
Secretary.

P. S.—Members will please advise the Secretary of any change in their address.

WATERWAYS IN GERMANY.

According to a recent report of the United States Consul-General at Frankfort, a monograph has been prepared in the Prussian Department of Public Works on the subject of the utilization of the water power created through the canalization of the Rivers Moselle and Saar. The report states that at the dams of the Moselle in Prussian territory about 35,000 H. P., and in the territory of Lorraine about 5,000 H. P., and at the dams of the Saar about 10,000 H. P. will be available, making in all a total of 50,000 H. P. This power will not at once be utilized at all the dams, and, if so, not to the full extent. For supplying larger amounts of power to the existing iron furnaces in Lorraine and in the Saar district, the furnace gases developed in the process are already used for generating power. For the larger cities, as Coblentz, Trier and Metz, however, the power of the dams in the vicinity could be profitably used, and the existing steam electricity works could be utilized as a reserve and supplement for the water power created by the new dams. This water power could also be made useful in running short railway lines—as, for instance, the recently constructed Moselle Valley Railway from Trier to Bullay—for the navigation of the canal in operating the sluices and guards, and could be supplied to the villages in the Eifel and Hunsrueck mountains, whereby home industries could be created in these poor districts. The expenses for a water power station consist of the cost of the turbine plant, and that of the creation and distribution of the electric current. No expense is incurred in the construction of a dam in the river, as it already exists in the interests of navigation. The utilization of the water powers, which in Germany has not hitherto received much consideration, will serve the public welfare on the one hand, and on the other is expected to assist materially in raising revenue for the purpose of canalization.

Wireless Telegraphy.

Dr. Erskine-Murray, of the Glasgow Local Section of the British Institution of Electrical Engineers, presented a paper recently which, in a most excellent manner, sets forth the present status of wireless telegraphy.

An abstract of this paper is given below, including the theoretical discussion, as well as the application of the theory to specific cases. In the earlier part of the paper the chief systems in use were briefly described. Methods of discrimination between stations by the use of equifrequent electrical vibrators at the transmitting and receiving ends were explained, and instances given, the most striking example being that reported by Captain Jackson, R. N., the exact details of which are as follows: The "Vernon" received signals from Poldhu, 180 miles distant, on one mast, and at the same time sent signals to a ship 50 miles away by a separate aerial on another mast about 200 feet from the first. The receiving was quite unaffected by the sending. Various forms of responders or detectors were then described, and mention was made of some recently patented systems which have not yet come into commercial use.

The Action of the Coherer.—The coherence of metal filings or surfaces was supposed at first to be due to electrical oscillations, and to be a test for their presence. I have never held the view that oscillations were necessary, believing that all that is required is merely an electrostatic field or difference of potential which causes the particles to join up in chains as do iron particles in a magnetic field.

That small particles do so in an electrostatic field has been shown by Robertson and others. When the ends of the particles come within a very small distance of one another a spark passes even if the voltage be low, and the welding takes place. The action is facilitated by very gentle intermittent mechanical shocks (tapping) just as in the case of iron filings in a magnetic field. Severe shaking, of course, prevents any chains from forming, or breaks up such as have been formed.

The action of a filings coherer thus takes place in two stages—first, the movements of the particles, and second, the welding.

That this view is correct has been amply proved by Dr. W. H. Eccles in an able experimental research which he undertook at my suggestion. He has also deduced a mathematical theory of the action which fits the results of experiment, and invented a method for testing coherers in the laboratory without the use of telegraphic apparatus.

Transmitters.—The electrical disturbance produced by the transmitter must be such that when it arrives at the receiver it produces, for however short a time, an appreciable difference of potential between the receiving aerial wire and earth. If the time rate of change of potential in the neighborhood of the receiver were slow, there would never be an appreciable difference between the aerial and earth, as the electricity would change its distribution very slowly as a minute current of insufficient magnitude to affect the receiver. A sudden change of potential is therefore necessary in order that a signal may be recorded. It is the horsepower which matters, not the total amount of work done.

In the systems most in use at present, the method of obtaining this sudden and energetic discharge is that of Hertz, i. e., the spark. It is Hertz's method of obtaining a sudden and oscillating discharge that is the essential in wireless telegraphy, not the fact that free radiations may be produced thereby. An alternator would be quite as suitable if it were capable of giving proper voltage and frequency, and, indeed, is being used by Fessenden.

Earth Connections.—When Marconi connected the lower ball of his Hertz radiator to the earth, he made the whole earth the lower ball. The earth and the aerial are the two conductors of the oscillator, which luckily is so unsymmetrical that it radiates very little indeed; in fact, the oscillations

simply spread from their point of generation over the two conductors.

Under these circumstances he at once obtained signals at a much greater distance than he had previously achieved. He had, in fact, introduced a conducting connection between the transmitter and receiver, instead of depending on radiations through the non-conducting atmosphere. The electrical waves produced were no longer free, but were guided by the earth's surface as an alternating current is guided by a wire.

For the intense currents of very high frequency, which are used in wireless telegraphy, a good and widespread earth-connection is most essential. It is not necessary that it should be a conducting connection, however; an inductive connection, in which the earth's surface plays the part of one plate of a condenser, is quite as effective for high-frequency currents.

Wireless telegraphs may thus be divided into two large classes—(1) conductively earthed; (2) inductively earthed.

In the first class come practically all the systems mentioned except some forms of Lodge-Muirhead apparatus.

In the Lodge-Muirhead station at Heysham the earthing is inductive. One large insulated plate is about 3 feet above the earth, the other plate is 80 feet above the first. Taking the average difference of potential between the earth's surface and the lower plate as roughly one-half of that between the plates, we find that the dielectric current between the earth and lower plate is 10 times as great as it would be through the spark-gap between the plates if the earth were not near. A conduction current in the earth's surface is thus induced by the proximity of the lower plate, and the waves are guided by the earth's surface as in conductively earthed systems. Radiations approximately resembling on a large scale those used by Hertz would not be obtained by this transmitter unless it were placed at least 800 feet or more above the earth's surface on a perfectly insulating support. Conversely, if Hertz had placed one end of his vertical oscillator within a small fraction of an inch of a horizontal sheet of copper, he would not have obtained free radiations, but a result which on the proper scale would resemble the transmission at Heysham. It seems probable that the inductive earthing in this case will prove as effective as an elaborate conductive system, and at the same time the advantages of a very persistent oscillator will be retained.

The Limit of Distance in Transmission.—The propagation of a hemispherical electric wave, in which the lines of force have their ends on a conducting plane surface, has been investigated by Heaviside, and from a wireless telegraphist's point of view by Blondel. Neglecting the curvature of the earth, the form of the wave is approximately the same as would be produced by removing the earth and putting another wire downwards from the spark-gap, this wire being equal in length to the aerial, and oppositely charged at every moment. If the electric waves used in wireless telegraphy retained this form we should find that the currents resulting from their action on the receiving aerial would vary inversely as the square of the distance. This does not, however, agree with Duddell and Taylor's measurements—the only definite measurements as yet published—of the variation of the received current with distance. They find * from experiments made between a station at Howth and H. M. T. S. "Monarch" in the Irish Channel, that the current at distances beyond 10 or 15 miles varies in almost exactly simple inverse proportion to the distance between the stations. This result admits of no question, the experiments having been carried out most carefully and with wonderfully concordant results. We must, therefore, accept the fact and look for an explanation in some circumstance which modifies the hemispherical waves originally given out by the transmitter when they attain a radius of about 10 miles.

I find that there is an explanation lying ready to our hand, which is based, not upon theory, but on the well-ascertained facts of the nature of our atmosphere. Put briefly, it is as follows: If the earth were surrounded by a spherical shell of conducting material it is a well-known fact that the waves would not die away in proportion to the square of the distance, but would vary, for moderate distances, in inverse proportion to the distance itself. Now, recent researches on aurorae by Danish observers have proved that these occur sometimes as low as six miles above the earth's surface, and never at a greater height than 60 miles. An aurora is an electric conduction current; hence the layer of air between 6 and 60 miles above the earth is conductive.

Here we have, then, the explanation of Duddell's law of variation with distance. The approximately spherical wave given out by the oscillator rises till it touches the conducting layer, then becomes annular, and travels outwards with a wave-front the area of which no longer increases as the square of the distance, but only in proportion to the distance itself, since the wave is confined by the parallel conducting surfaces above and below. Thus the only space-variation which causes diminution in strength is the increasing radius. There is, of course, in addition a frictional loss of energy which we shall consider later.

If we take the curvature of the earth into account, and proceed to trace the variation of the wave-front at greater distances than those of Duddell's experiments, which only extended to 60 miles, we find from simple mathematical, or rather geographical, considerations that the radius of the circle in which the wave-front cuts the globe is directly proportional to the sine of the angle at the earth's center subtended by the arc of the surface between the transmitter and the wave-front. This agrees with Duddell's law because for small distances sin t is nearly equal to t. For greater distances, however, the divergence becomes less and less, and at distances beyond 6,000 miles, i. e., beyond $t = \mathrm{Pi}/2$, the waves converge, and the current should increase with distance. This is true on any theory, as the wave-front is becoming a smaller and smaller ring, continually converging from all sides towards the antipodes of the transmitting station.

The equation for the received current is thus of the form:

$$c = \frac{C}{\sin t}; \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (A)$$

where c is the received current, t the angle defined above, and C a constant.

The above law of variation of the received current with distance is obviously not complete. We have so far supposed that the lowest layer of the atmosphere is a perfect dielectric, and that the earth and upper atmosphere are perfect conductors, i. e., that no dissipation of energy is involved, the decrease of current being simply due to increase in area of the wave-front.

We must now take account of frictional losses, in order to complete the law as far as possible; though with the data at present available only a rough approximation can be attempted. It will be possible to amplify the equation when further measurements have been made, and to determine more exactly the functions and constants involved.

The first indication of a true frictional dissipation of energy in transmission was found in Marconi's discovery that messages could be received at much greater distances during the night than by day. There cannot be much difference between the divergence variations by night and day, as the earth does not change its shape; this phenomenon has therefore to be explained by some difference in the electrical properties of the transmitting media. Now the conductivity of the earth cannot be seriously altered by the sun's rays; the atmosphere, however, may be much affected. Cosmical Science has made many striking advances lately, and it is now practically certain that streams of electrified particles, resembling the cathode rays, are ejected from the sun with a very high velocity. These penetrate the earth's atmosphere on the day side, electrifying it, and at the same time ionising

*Journal of the Institution of Electrical Engineers, July, 1905.

it, thus rendering it more conductive. During the night equilibrium becomes slowly restored, and towards five o'clock in the morning a very marked minimum of atmospheric electrification has long been known to exist. The time at which signals go furthest thus coincides with a minimum conductivity of the lower layers of the atmosphere, while greater conductivity of the lower layers during the daytime coincides with greater difficulty in transmission.

Now an electric wave must have either an all-dielectric medium or a dielectric bounded by conductors; it cannot penetrate far through a conductor. Thus if all the atmosphere were conductive the wave would travel only a very short distance before being dissipated by resistance, and transmission to a great distance would be impossible. The conditions would be similar to an attempt to transmit current along a concentric cable with bad insulation between the conductors. The good insulation is just as essential as the conductors. We may take it, then, that during the night the lowest 10 miles of the atmosphere is a good dielectric, while during the day it becomes slightly conductive.

To obtain a rough estimate of the amount of this dissipation we may take Mr. Marconi's statement that 500 miles during the day is equivalent to 1000 by night. The variation is not so noticeable at short distances, being in this case so very much less important than the divergence, though it is distinctly traceable in Duddell and Taylor's results.

Let us assume that the law of divergence is that given above—Equation (A)—i. e., that the undissipated current would vary inversely as the sine of the angle between the places, or approximately, for the distances under consideration, inversely as the distance along the earth's surface.

We then have Duddell's law—

$$C \times D = \text{constant}$$

where C is current received, and D is distance between the stations.

Now assume as a first approximation that there is no dissipation at night; then the current lost, by divergence only, between 500 and 1,000 miles at night is all spent by dissipation during the day before 500 miles is reached. Again, the divergence alone between 500 and 1,000 miles would reduce the current to one-half, since 1,000 is twice 500. Therefore the current at 500 miles during the night is twice the current which will just work the receiver. The current lost by dissipation during the day throughout 500 miles is therefore equal to that which will just work the receiver. We have thus obtained an approximate value of the dissipation from Mr. Marconi's experiments. If we call the minimum working receiver current of Mr. Marconi's receiver M, then the current lost through dissipation is roughly M/500 per mile.

This dissipation is no doubt a function of the distance, the form of which I hope to be able to determine later. It is also, of course, a function of the state of the atmosphere, as regards electrification, and varies from a minimum in the very early morning to a maximum in the evening. In the meantime we may take M/500 as a rough approximation to its average mid-day value, under the circumstances considered.

The approximate equation $c = C/\sin t$ for propagation of signals then becomes—

$$c = \frac{C}{\sin t} - \frac{M}{500} d \quad . \quad . \quad . \quad . \quad . \quad . \quad (B)$$

where—

c = received current,
C = a constant,
M = minimum current which will actuate receiver,
d = miles distance,

and—

t = angle subtended at centre of earth by arc d.

Now since $d/3500 = t$, approximately, since the earth's radius is 3,500 nautical miles, $\therefore d = 3{,}500\ t$.

To determine C from (A) we notice that $c = C$, if $\sin t = 1$, i.e., if $t = \text{Pi}/2$. C is thus the value of c at 5,400 nautical miles, or an earth quadrant from the transmitter during the night, i.e., when *no* dissipation. We may state it as $C = kM$ if we like to take M as a unit, i.e., the undissipated current at 5,400 nauts. is k times that necessary to work the receiver.

The equation then becomes—

$$c = M\left(\frac{k}{\sin t} - 7t\right) \quad . \quad . \quad . \quad . \quad . \quad (C).$$

To find the limit of distance with any given power we must have $c = M$, i.e., the current at the receiver is just the smallest possible working current.

The equation (C) then becomes:

$$1 = \frac{k}{\sin t} - 7t \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (D)$$

or—

$$k - \sin t\ (7t \text{ plus } 1) = 0 \quad . \quad . \quad . \quad . \quad (D^1)$$

The number seven in this equation is only a rough approximation, suitable to the case under consideration. It should properly be replaced by some function of t.

Let us now consider Duddell and Taylor's results for shorter distances in the light of this explanation.

Remarking on the slight decrease in the product C × D at long distances, they suggest reflection from the Hill of Howth as a cause, mentioning that another possible, but apparently less probable, explanation is that the cross-channel runs were made in damp, misty daylight, while the up-and-down channel course was made in the night and early morning with a clear, frosty atmosphere. To me this latter suggestion is far more probable than the first. We know that such a difference exists from Marconi's results. It is worth while to attempt to derive it from Messrs. Duddell and Taylor's measurements. We may take from their curves the following data, comparing the day and the night experiments:

(1) *Night.*

"Monarch" Coming South towards Howth.

Distance off Howth	... 18	... 36	Miles	
C × D	... 3850	... 3920	Micro-amperes × Miles.	

Thus at 18 miles the current was 214 mA., and at 36 miles 106.1 mA.

Now, by divergence alone the current would at 36 miles have been one-half that at 18 miles, i. e., 107 mA. The dissipation loss is thus 0.9 mA. in 18 miles, or roughly 0.05 mA. per mile on 214 mA.

(2) *Day.*

In a similar way we may obtain by averaging curves, representing the same quantities on the voyage to Holyhead and back during the day, the value 7.2 mA. lost between 30 and 60 miles off Howth. This amounts roughly to 0.24 mA. per mile on a maximum current of 120 mA. Reducing the result given in (1) to suit this maximum current, we see that the dissipation by night is to that by day in the ratio of about .025 to .24, i. e., the dissipation during the day is approximately 10 times as much as at night.

Messrs. Duddell and Taylor attempted to measure the day and night variation between Howth and Kingstown, but did not find as much as 1 per cent. difference. This was natural, as these points are only about six miles apart, hence the total dissipation was very small in both cases. The difference of the values for night and day which I have deduced above would barely amount to 1 per cent. of the total in five miles.

Comparing the value of the dissipation determined from Marconi's experiments with that obtained from Duddell and Taylor's, we find that they are of the same order of magnitude. Nearer than this we cannot at present go, since the minimum working current of Marconi's long-distance receiver is not known.

In the present communication it is impossible to develop the subject further; I hope, however, that I may have an opportunity later of amplifying and substantiating the main framework of the theory which I have given. Doubtless it is very rough, and in many parts incomplete, but it will, I hope, form a foundation for a more thorough explanation of wireless telegraphy.

It has been shown experimentally by J. J. Thompson that the conductivity of rarified air, at a certain pressure, for electrodeless discharges, is as great as that of a 25 per cent. solution of sulphuric acid, and that a layer of such air half an inch thick forms a perfect screen for electric waves. A layer of air at this pressure must exist in the atmosphere at a very moderate height.

The same experimenter has also proved that there is a critical pressure at which the air becomes conductive. Under greater pressures it is practically an insulator, and at smaller pressures a good conductor. The commencement of the conducting layer in the atmosphere is thus sharply defined.

If an electric wave be a cylindrical shell of constant height between parallel conductors, the surface density, and thus the displacement and electric force, will vary inversely as the diameter of the cylinder. The energy per unit volume varies as the product of these quantities, and will therefore vary inversely as the square of the diameter, and be uniform throughout the shell. In the case of a hemispherical wave of the type considered the distribution of energy is not uniform. At the base the limiting form of the wave is cylindrical, as in the previous case, and its energy is the same, while in the vertical line through the origin the energy is zero. Either type of wave will therefore agree with the results obtained by Duddell and Taylor, but the facts as to the conductivity of the upper atmosphere, and the variations in dissipation, noted above, are in favor of the cylindrical theory.

REVOLUTION IN TROLLEY LINES.

The art of street railroading is changing so rapidly that railroad men hardly know where they stand. The larger companies are now "scrapping" cars which a few years ago represented the latest improvements, not because they are worn out, but because they are already considered obsolete. Powerhouses are dwarfing the stations which were once considered more than adequate to meet any demand that might be made upon them, and engineers cannot even hazard a guess at the time when the growth will stop.

The revolution wrought by new machinery, new equipment and new methods has made a street railroad almost as elaborate a system as a long-distance steam road, and one which requires an equal amount of care. Of the money needed to operate surface cars in a city, almost one-half is spent on keeping the roadbed in good order, on inspecting and repairing the trolley stock, on renewing trolley wires and on the maintenance of the power machinery. How long, with this care, it would be possible to make the plant endure is difficult to state accurately, for in the history of electrical transportation in America there are few instances of a plant having remained in use until worn out. Ordinarily its various parts are thrown into the scrap heap to make way for a fresh improvement.

The life of a great part of a traction company's property, however, can be only little prolonged by the best of care. The 94-pound rails, for example, which are now the standard for city use, rarely last more than fifteen years, when there is any considerable travel over them, and in places it is necessary to renew them every year. A more important factor in the wear and tear on a rail than the volume of traffic passing over it is the degree of curvature. A stretch of straight track will last at least six times as long as the rails of a sharp curve which carries the same amount of travel, and when to the curve is added a heavy grade the life of the steel is short indeed. One of the best instances of this is to be found at the Manhattan end of the Brooklyn bridge. Over the complicated "layout" at this point as many as 320 cars pass in an hour during the crowded times in the morning and evening. As the weight of each car is at least twenty tons this means that 6,400 tons are swung around the sharp curves every hour—more than 100 tons a minute. Much of this "layout" it is necessary to renew every year, and even those parts which have been equipped with manganese steel, the most durable as well as the most expensive form of rail known, do not last much longer.

To construct a mile of single track railway in a city street costs, it is estimated, about $30,000. To maintain it properly costs annually something more than $1,300, or between 4 and 5 per cent of the original investment. Of the total expense of operation about 5½ per cent is devoted to maintaining the track and roadbed.—New York Tribune.

A WELL DESERVED TRIBUTE.

The "Gas World" of July 14th, speaking editorially upon the recent article by F. H. Shelton in the "Progressive Age," descriptive of the effect of the disaster of April 18th upon the gas plants of San Francisco, pays a glowing tribute to the employees of the San Francisco Gas and Electric Company, which we reproduce below. Those who were here at the time know how absolutely true the statements of the "Gas World" are, and the importance of the heroic work done at that time by everyone connected with the company:

"No gas manager, wherever his lot may be cast, will feel other than a desire to echo, with all his heart, the warm admiration expressed by Mr. F. H. Shelton for the splendid steadfastness and resource displayed by the gas men of San Francisco in the emergency brought about by the terrible earthquake and fire which destroyed one-half, and the better half, of the city on April 18th last. Henceforward this date will be marked in the calendar as that of the most tremendous catastrophe of the kind which has occurred within historical time.

"It is worth noting that so far from the gasworks contributing to the damage done, either by explosion or fire, as nervous persons unacquainted with the nature of the industry might expect in such circumstances, the first use to which the restored supply was put was the extended cooking of food for the dishoused population. Owing, as Mr. Shelton testifies, to the demolition of almost every chimney in the town, and the danger of ordinary fires in houses, without water supply or protection in case of fire, the Emergency Committee ordered all cooking to be done out of doors, 'excepting where gas stoves requiring no chimneys were available.' This picture of an unparalleled situation receives a final touch in the context, when we are told that one of the first things that the gas company did was to send for 5000 gas cookers in order to make the best of the opportunity for getting back in this way some of the business lost by the destruction of so much of the district. Hats off, indeed, to these brave and busy San Francisco gas men!

"One can picture, by the aid of Mr. Shelton's graphic description, the busy gangs seeking out main breakages, and patching them up by the readiest means at hand; while others went through the houses left standing, testing for leaks and restoring the supply where possible. It is truly wonderful that in only 1 or 2 per cent. of the houses were leakages detected of such importance as to prevent turning on the gas. Wherever the praises of good servants of the public are told, surely this story of the pluck and resourcefulness of the San Francisco Gas & Electric Company and its men is deserving of mention. 'Peace hath her victories no less renowned than war;' and just as truly as the splendid story of how the English-speaking people of the stricken city rose to the emergency makes the ears of those of the race who hear it tingle, so let the part played by the humble gasworks hands and their able chiefs be treasured as something of which the followers of the world-wide gas industry may legitimately be proud."

INDUSTRIAL.

PIERSON, ROEDING & COMPANY'S SAN FRANCISCO OFFICE.

The Pierson, Roeding & Co., successors to John Martin & Co., and the Martin Pipe & Foundry Co., on August 1st occupied their permanent offices in rooms 409-415 Monadnock Building. This firm immediately after the disaster opened temporary offices on April 22d, in the Blake Block, Oakland. The Oakland office will be discontinued after this week. Their Seattle office is in the Colman Building, and their Los Angeles office in the Pacific Electric Building.

This firm has two distinct departments—the Electric Department and the Pipe Department. The Electric Department includes the agencies of the Locke Insulator Mfg. Co., manufacturers of all kinds of insulators; the Pittsburg Reduction Co., aluminum wire; the Lombard Governor Co., water wheel governors; the Ohio Brass Co., railway overhead material, rail bonds and electric railway specialties; the Fibre Conduit Co., manufacturers of fibre pulp underground conduits for use in telephone, telegraph and electric light and power distribution systems, and the Riter-Conley Mfg. Co., who build steel transmission towers. The Pipe Department includes the Dimmick Pipe Co., manufacturers of cast iron, water and gas pipe, and the Coosa Pipe & Foundry Co., soil pipe and fittings. The Pierson, Roeding & Co. handle the manufactured products of the Coosa Pipe & Foundry Co., for sale to the trade only.

Their warehouse, which is located in San Francisco even at this early date, contains a large percentage of their former stock.

It is unnecessary to say that the members of the firm are most happy to get back to San Francisco, and they are to be congratulated upon their handsome and commodious new offices.

NEW POWER STATION OF THE SAN JOAQUIN POWER COMPANY.

About 50 miles northeast of Fresno, on the north fork of the San Joaquin river, in the Sierra Nevada mountains, a new hydro-electric plant, owned by the San Joaquin Light & Power Company, of Fresno, Cal., was put in operation in April of this year. The actual work for construction of this plant was begun in May, 1905, but has been delayed by the fact that all material, except lumber, had to be transported into the mountains on freight teams.

The conduit supplying water for the operation of this plant has a total length of 4.3 miles, and comprises open canal, tunnels, flumes and pipe line. These structures are designed for a flow of 100 cubic feet per second and, with the total head of 400 feet, give a total capacity of 3600 horsepower. The canal is 5 feet wide on the bottom and 3 feet deep. It is lined throughout with concrete. The intake basin and the fore-bay are concrete structures and the tunnels are also lined with concrete. The flumes are of steel plate ⅛-inch thick, semi-circular in form and 6 feet wide. The pipe line is 3000 feet long and 52 inches in diameter, the thickness of steel varying from 3-16 inch to ½ inch.

The water wheels are the tangential type, two in number, and are guaranteed to develop 83 per cent. efficiency under full load.

The electric generators, two in number, have a capacity of 1000 kilowatts, 300 R. P. M., 550-volt, 3-phase. Each machine is provided with a base and two bearings. the shaft at each bearing being extended to carry an overhung water wheel. The exciters are direct connected, having armatures mounted on the generator shaft between the bearings. Each exciter is 62½-kilowatt output and easily capable of furnishing exciting current for both alternators.

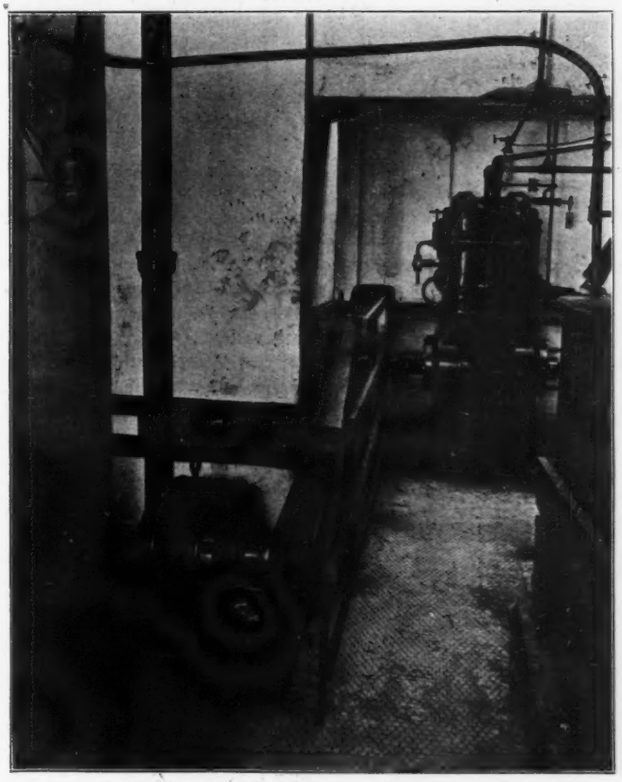
The revolving field type of alternator is used with the motor, specially constructed for high peripheral speed, which in these machines reaches as high as 7500 feet per minute.

The plant whose equipment is described above is the second one constructed by the San Joaquin Light & Power Company. The original plant is to be reconstructed and enlarged and there are plans for other new plants to be built later.

ELECTRICALLY OPERATED REFRIGERATING PLANT IN THE GALLATIN HOTEL, UNIONTOWN, PA.

Mechanical refrigeration employing electric motors as its source of power is covering a very broad field and has almost unlimited application in the preservation of food products and maintaining a low temperature in many industrial processes, as well as in domestic and household use.

In some cases the adoption of mechanical refrigeration depends greatly upon the question of economy, and in others cost is sacrificed for cleanliness, convenience and easily controllable temperature. Refrigeration is not confined to the cooling of various products, however, but is largely used in furnishing cooler air in private and public buildings during the heated seasons of the year.



The machines now used to produce a reduction in temperature are nearly all based on the principle of production of cold by the evaporation of liquid to the gaseous form; and of the many systems of ice-making and refrigerating in extensive use today, the ammonia compression system occupies a pre-eminent position. It consists of a complete cycle of operations, involving three successive steps—compression, condensation and expansion. These three steps are made continuous and are constantly repeated.

To illustrate the foregoing remarks, we give a description of the refrigerating plant in the Gallatin Hotel at Uniontown, Pa.

The ammonia compressor, made by the Brunswick Refrigerating Company, is driven by a 10-horsepower Westinghouse type CCL motor. From the compressor the liquid ammonia is circulated in coils within the brine tank and returns in a gaseous form. The cool brine is used for the

double purpose of making ice for table purposes and for cooling the beer cellar and ice boxes. Ice cans filled with fresh water are submerged in the brine tank, and the average output of ice is six tons per day.

A circulating pump, driven by a Westinghouse 2-horsepower, type CCL motor, forces the brine to the beer cellar, which is 9 feet by 16 feet by 7½ feet, and is maintained at an average temperature of 40 degrees F. Besides the beer cellar there are three ice boxes, each 5 feet by 6 feet by 7 feet, and one cook's box 4½ feet by 5 feet by 7 feet. Two of the ice boxes are used for freezing purposes and are maintained at an average temperature of 16 degrees F.

The entire plant is taken care of by a young boy, which clearly shows the simplicity and economical operation of refrigerating plants driven by electric motors.

A FEW OF THE RECENT SALES OF THE ALLIS-CHALMERS CO., MILWAUKEE.

Contracting Department.

Salt Lake Tribune Publishing Company, Salt Lake City, Utah, three Reynolds Reliance Corliss engines, three D. C. generators of 100, 150 and 250 kilowatt capacity, two 25 kilowatt balancer sets, two 15 kilowatt balancer sets, complete power station auxiliaries, including boilers, feed water heaters, switchboard, piping, stack, etc.

Indianapolis, Newcastle & Toledo Ry., Indianapolis, Ind., complete power station, including building and all steam and electrical equipment, consisting of two 1,000 kilowatt A. C. turbo-generators, six 350 kilowatt O. F. W. C. transformers, nine 150 kilowatt O. F. S. C. transformers, three 150 kilowatt O. F. W. C. transformers, four 400 kilowatt rotary converters, eight 75 horsepower quad-railway motor car equipments, eight complete Christensen air brake equipments, complete switchboard equipment, complete boiler plant, three complete substations and 5,000 tons 70-pound steel rail complete.

Gas Engine Department.

Indiana Steel Co., Gary, Ind., seven 2,000 kilowatt gas engine generating units, two 2,000 kilowatt D. C. gas engine generating units.

Illinois Steel Co., Bay View Mills, Milwaukee, Wis., 32x42 inch Randem gas engine, 500 kilowatt D. C. generator.

Trenton Iron Co., Trenton, N. J., 350 kilowatt gas engine generating unit.

Cement and Crushing Machinery Department.

J. M. Dwyer, Glenlyn, Va., No. 3 D crushing plant.

Newaygo Portland Cement Co., Newaygo, Mich., 5x22 foot Gates tube mill.

Freeborn Engineering and Construction Co., Kansas City, Mo., 8.5x22 foot Gates tube mill.

Fort Smith Light and Traction Co., Fort Smith, Ark., No. 4 style "K" crushing plant.

Pennsylvania Cement Co., Bath, Pa., 7x7 foot Gates ball mill.

Montello Granite Co., Montello, Wis., No. 6 style "K" Gates breaker.

Crystal City Sand and Gravel Co., Crystal City, Mo., No. 5 "K" crushing plant.

Tavern Rock Sand Co., Klondike, Mo., No. 5 "K" Gates breaker.

Portland Gold Mining Co., Colorado Springs, Colo., two 5x22 foot Gates wet grinding tube mills.

Mining Department.

Bullychoop Gold Mining Co., Trinity County, Cal., complete hydraulic electric transmission and mining equipment, including a 20-stamp mill, induction motors, a 450 kilowatt generator, direct connected to water wheels, and a transmission line three and one-half miles in length.

Camp Bird, Ltd., Ouray, Colo., thirty 6-foot standard Frue vanning machines, stamp mill machinery, etc.

Wheeling Milling Co., Mine La Motte Station, Mo., 25-foot Hancock jig complete.

St. Joseph Lead Co., Boone Terre, Mo., Standard 25-foot Hancock jig complete.

WESTINGHOUSE-PARSONS TURBINES.

The Union Portland Cement Co., Ogden, Utah, recently ordered two 1200-kilowatt Westinghouse-Parsons steam turbines for their plant at Portland, Utah. The turbines will operate on 175 pounds steam pressure, 27-inch vacuum, and no superheat, driving enclosed type turbo-generators delivering 480 volts at a frequency of 30 cycles to a three-phase distribution system. The turbines will operate 24 hours per day, generating power for motor-driven machinery throughout the mill and electric locomotives operating between the quarry and the mill.

A 750-kilowatt Westinghouse-Parsons turbine is destined for the Pittsburg Reduction Company's plant at East St. Louis, Ill., operating non-condensing on a steam pressure of 150 pounds.

The California Powder Works have added another turbine to their plant at Pinole, California. This machine runs parallel with a 400-kilowatt Westinghouse-Parsons unit already installed at the plant, and through static transformers with 250-kilowatt reciprocating engine units, with which the present 400-kilowatt unit is now operating successfully. This turbine has made a remarkable record for itself. Starting on July 27, 1905, it has operated continuously for nearly a year with but one shut down for the purpose of inspection.

TEST OF SKINNER ENGINE.

We give herewith the results of a test made by Prof. Carpenter, of Cornell University, on a tandem-compound, non-condensing engine built by the Skinner Engine Company, of Erie, Pa., and installed in the Ellicott Square building in Buffalo, N. Y. The test was made to determine whether the engine met the guarantee for steam consumption, which was essentially 23.5 lb. per hp-hour with 125 lb. steam pressure at the throttle, the engine exhausting into the atmosphere. The engine was also guaranteed to regulate within 2½ per cent in changing from no load to full load and to resume its normal speed after such changes within six revolutions of the crank shaft. The engine tested has cylinders 16 in. and 27 in. in diameter and a stroke of 18 in. It was designed to run at 225 r.p.m. and to produce 375 indicated h.p. at full load. The piston rod connecting the high and low-pressure pistons is 2¾ in. in diameter and the rod from the low-pressure cylinder is 3¼ in. in diameter. A fly-wheel governor is used and this is arranged to control the high-pressure valve only.

The steam consumption was determined by weighing the water supplied to the boilers; but prior to performing the test, the leakage of the boilers and piping was determined. The engine test was continued for six hours without interruption and indicator cards were taken every fifteen minutes, as well as readings of the gauges, meters, etc. Observations of the quality of the steam were taken at intervals and a determination made of the amount of steam drawn off from the main pipe during the test by the calorimeter. The following shows the average results of the tests in tabulated form:

Total dry steam fed to engine in lbs	48660
Average revolutions per minute of engine	226.66
Average steam pressure in lbs	129.4
Average voltage of dynamo	114.92
Average amperes	2038
Average indicated horse-power	383.1
Maximum indicated horse-power	402.8
Average kilowatts	235.43
Maximum kilowatts	251.85
Average electrical horse-power	315
Maximum electrical horse-power	336.5
Average delivered horse-power	347
Maximum delivered horse-power	366

Friction horse-power, average 36.1; maximum, 36.8

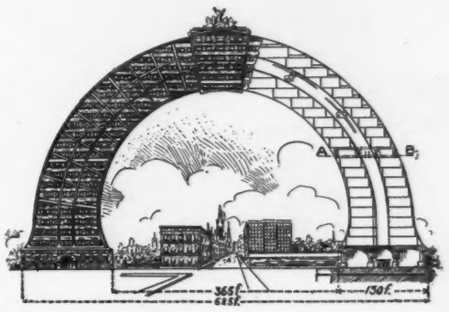
The electrical horse power equalled 91 per cent of the delivered horse power by electrical contract; the friction horse-power was 9.45 per cent for average load and 9.15 per cent for maximum load. The dry steam per indicated horse power per hour was 21.1 lb.

During the test the horse power of the engine varied from 370 at the beginning to a maximum of practically 403. The speed of the engine was taken by a very accurate Horn tachometer and varied from 225 to 227.5 r.p.m. After the completion of the economy test, the regulation of the engine was tested by suddenly throwing off the greater portion of the load and suddenly throwing it on again. With a change in load from 2,100 amp. to 1,400 amp., there was a sudden swing of the tachometer needle corresponding to a few turns of change in speed. When the load of 1,400 amp. was thrown off suddenly, the tachometer needle jumped forward and then backward three or four times, settling at 226 r.p.m. in a short space of time. A load of 1,400 amp. was then suddenly thrown on with the same rapid vibration of the needle. There could, therefore, be no question as to the satisfactory regulation of the engine.

The engine ran throughout the test with practically no noise and no noticeable vibration. As to the relative economy of this engine, Prof. Carpenter states that so far as he can ascertain the results are better by about 3 per cent than that of any other similar engine working under similar conditions about which he has been able to find any record. This is attributed to the small clearances in the low-pressure cylinder obtained by the use of an independent shifting eccentric operating the low-pressure valve, as shown in the accompanying illustration. The point of cut-off in the low-pressure valve can be changed to suit the average conditions after they have been determined, so as to get the maximum economy for these conditions. Changing the point of cut-off with this device does not necessitate equalizing the lead, and a lower percentage of clearance in the low-pressure cylinder is obtained by the use of this independent eccentric.

BUILDING IN FORM OF AN ARCH.

There is no real reason why a building should be built in one solid, quadrangular pile, except that that is the easiest and cheapest method. But we are not looking for the easiest and cheapest ways of doing things at the present time, if other ends are not conserved also. And there are many good reasons for constructing a building in some other shape. At least so argues Jules Gernaret, the Belgian engineer who designed the arch-shaped structure shown in the cut.



BUILDING DESIGNED BY BELGIAN ENGINEER.

The design shows a building of twenty-one stories, rising to a height of 400 feet. Iron and cement are the materials to be used in construction. The inventor declares the elasticity obtained between the two or more resting points of the structure will make it earthquake proof. A combination of elevator and trolley car will carry tenants to the various floors.

While the general design is a decided innovation, and will be termed "outlandish" by even the progressive clique of architects and engineers, it is interesting to note that elevators which run on a curve, similar to those shown in the drawing, are already in use; and in conservative Boston at that. They are at the new Atlantic Chambers railway station, and carry passengers from the East Boston tunnel to the Atlantic avenue elevated line.—Building Management, Chicago.

STEAM TURBINES IN PUBLIC LIGHTING PLANTS.

The Public Service Corporation of New Jersey has recently placed orders with the Westinghouse Machine Co. of East Pittsburg, Pa., for two 1,000 KW. and and one 500 KW. Westinghouse-Parsons steam turbines. The first two are to be installed in their plant at Cooper's Creek, Camden, N. J., and the latter at Cranford, N. J.

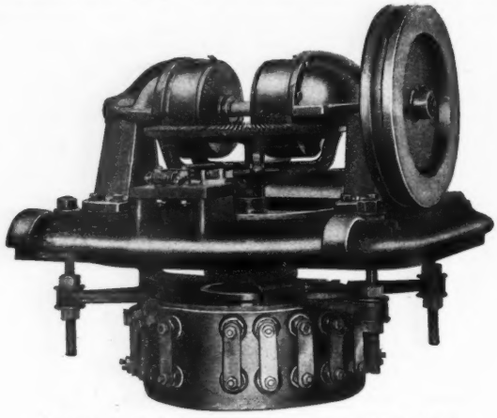
The new station at Cooper's Creek will contain three turbines of 1000 K.W capacity, the first one having been ordered some time ago, as an extension to the old Corliss engine equipment. These turbines will operate under 150 pounds steam pressure, 28 in. vacuum and 100 deg. superheat, and will be direct-connected to 1000 K.W. Westinghouse enclosed type turbo generators, delivering 2,400 volts to a two-phase 60-cycle distribution system. This plant will burn soft coal under six 500 H. P. Sterling Consolidated water tube boilers of the Babcock & Wilcox type, and will use Foster superheaters and Williamson condensing system.

The Cranford turbine will also deliver 2,400 volts current at a frequency of 60 cycles to a two-phase distribution system.

The turbine will operate under a steam pressure of 125-140 pounds and 26 in. vacuum. The Wheeler surface condensing system will be used.

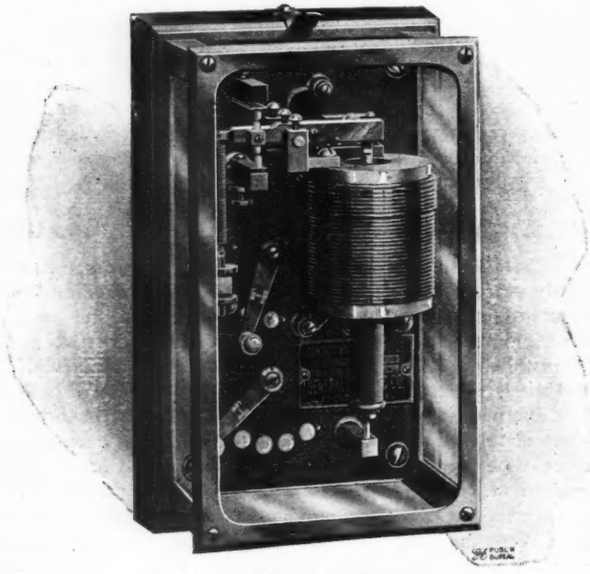
AUTOMATIC FEED REGULATORS.

Proper voltage regulation of individual feeder circuits for both power and lighting is recognized as an important factor in the economical operation of a power plant. Such regulation may be controlled by the station attendants or automatic methods of regulation may be adopted. For automatic regulation of feeder circuits the General Electric Company manufactures two forms of voltage regulators which are of special interest, known respectively as type BR and type IR. The general principle of operation of both these forms of regulators is similar in that they are in effect variable ratio transformers or compensators having two separate windings. The primary or shunt winding is connected across the line, while the secondary or series winding is connected in series with the line to be controlled. While both forms of regulator boost or lower the voltage by changing the transformer ratio, the methods used in the two cases are quite different.



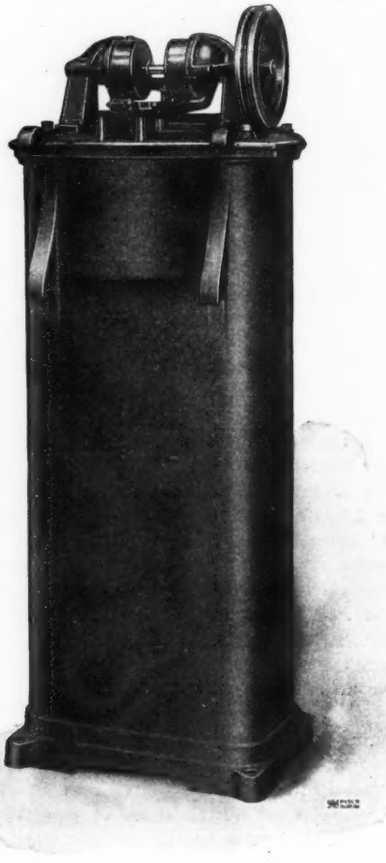
SWITCHING MECHANISM OF BR REGULATOR.

In the BR type of regulator the windings are assembled on a shell-type core and taps are brought out from the secondary winding to stationary slip rings. The various combinations of turns producing the voltage change are made by the controlling mechanism of the regulator. In the IR type of regulator, on the other hand, the secondary and primary windings are assembled upon separate cylindrical and concentric sheet iron cores. The series or secondary winding is arranged in slots on the inside circumference of the stationary outer core, and the shunt or primary winding is placed in similar slots on the outside circumference of the movable inner core. The change in the angular position of these cores varies the flux distribution and so produces the boost and lower in the voltage. The coils on both stationary and movable cores are in effect polar windings and both are similarly wound. With a given pole of the primary opposite a given pole of the secondary, the regulator will boost the line voltage, while if dissimilar poles are opposite, the voltage will be lowered.



CONTACT MAKING VOLTMETER.

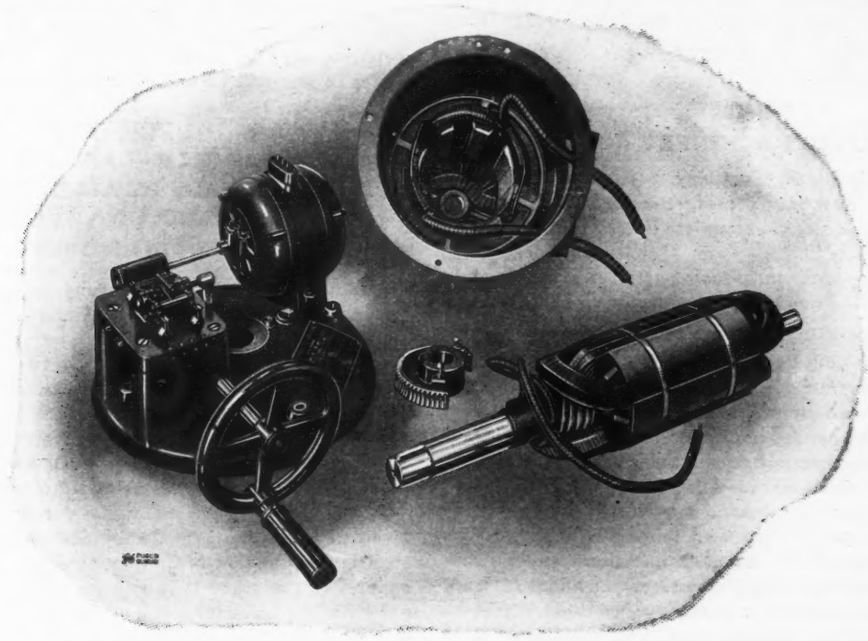
IR TYPE REGULATOR.



BR TYPE REGULATOR.

The mechanical arrangements of the regulators are compact and simple. In the BR regulator, in which there is no moving core, the connection changes are made by a rotating switch. The moving member of this switch carries a series of fingers, each of which is connected to a corresponding stationary collector ring by means of a suitable brush, and the ring is connected to a line through a preventative resistance. This resistance allows a small exchange of current between the fingers, and thereby prevents any break in the circuit when passing from one step to another. The switch is operated on a vertical shaft by a bevel gear, which in turn is driven by magnetic clutches on the horizontal shaft, the switch rotating in one direction or the other depending upon which clutch is excited.

In the IR type of regulator the mechanical arrangement is exceedingly simple. The movable or primary core is mounted on a vertical shaft, the upper end of which carries a worm-gear segment, while the other end rests in a step bearing. Both primary and secondary windings are brought out by means of flexible cables, with the exception of large regulators for rotary converters, which have the secondary arranged with bus-bar terminals. The entire arrangement is simple and substantial in construction, and with the exception of the windings, is practically indestructible.



PARTS OF IR REGULATOR.

Both types of automatic regulators are operated by polyphase motors, but the method of control is different. In the IR or movable core regulator the operation is as follows: Across the potential transformer in the feeder line is placed a contact-making voltmeter, the regulator being in series with the line. As the line voltage rises or falls the contact-making voltmeter responds, making contact on one of two points, respectively. These contacts in turn close the circuits in a relay switch, which starts the polyphase motor. This relay switch operates the motor in either direction according to the "boost" or "lower" position taken by the contact-making voltmeter. The motor then revolves, adjusting the main circuit voltage by changing the angular position of the cores as described, until the line voltage becomes normal. At that instant the contact-making voltmeter opens, in turn opening the relay switch and the motor circuit.

In the BR type of regulator the contact-making voltmeter forms an essential part of the control, but the relay switch is omitted. In this type of machine the driving motor, which may be of any type, revolves continuously, but operates the revolving-switch mechanism only when the magnetic clutches on the horizontal shaft are energized. A single motor may operate a number of regulators. The contact-making voltmeter, responding to the rise and fall of the line voltage as in the case of the IR regulator, sends a direct current through one or the other of the clutches. These clutches then rotate the switch by means of the mechanical arrangement of the bevel-gear drive, as explained. If it is desired to compensate for line drop and maintain a constant potential at some distant point on the feeder it is only necessary to provide the relay with a compensated winding, connected in series with the line, or through a suitable current transformer. The compensated winding on the relay is arranged with two sets of dials, as shown, so that a very close adjustment can be obtained within the limits for which the device is designed. In the IR regulator, where there is considerable inertia in the moving parts, a magnetic brake operates when the motor circuit is opened, which prevents hunting, but this device is not required on the BR type, since the parts are light and stop when released by the clutches.

Each of these regulators has its individual application, according to the operating conditions. The BR regulator is particularly designed for feeder circuits, where the fluctuations in voltage are very rapid. Such conditions are imposed when both lamps and induction motors are operated on the same circuit. The rush of current taking place when a large induction motor is thrown on the line makes the lamps flicker unpleasantly unless a quick-acting regulator is provided. The BR type of regulator meets these conditions and smooths out the fluctuating voltage curve, as it operates over its full range from lower to boost in six seconds. The IR type, on the other hand, is well adapted for lighting circuits where the load comes on more gradually and such quick regulation is not essential, as, for example, the regular lighting load at a power station, which increases rapidly toward nightfall.

While both these types of regulators have very good efficiencies and power factors, these are of relatively small importance. Take, for example, the IR type of regulator. Feeders seldom require a regulation exceeding 20 per cent., and a regulator having even as low a power factor as 85 per cent. does not have any appreciable effect on the line. Such a regulator would have a magnetizing current and a reactance

exceeding 25 per cent, and assuming that the regulator is arranged for a 10 per cent. boost and lower, and that the power factor on the line is 100 per cent., the effect of the regulator having this low power factor and with full load on the line will only reduce the power factor on the line 0.2 per cent.; in other words, the power factor would become 99.8 per cent. With a 5 per cent. boost and lower regulation under the same conditions the line-power factor would be 99.9 per cent. It is therefore evident that the reactance in the regulator has a neglible effect on the power factor of the system as a whole.

Both types of regulators are built in standard sizes for 60 cycles and 2200 volts, to boost and lower the voltage either 5 per cent. or 10 per cent. above and below normal. The BR regulator is usually built in sizes from 11 to 22 kilowatts, while the IR types for single or polyphase circuits range in size from 5.5 kilowatts to 44 kilowatts. Their capacity, however, is practically unlimited and has already been extended to 1200 kilowatts. The General Electric Company is also prepared to furnish automatic regulators of the same general construction as the standard types, but wound for special voltages or frequencies.

THE HALLIDIE MACHINERY COMPANY.

The Hallidie Machinery Company, 315-317 Second avenue South, Seattle, are now representing the Chicago Pneumatic Tool Co. and carry in stock a complete line of their Boyer air hammers. Also the Chicago and McKiernan rock drills, Franklin air compressors, and repair parts for same, in addition to a large stock of machine tools constantly kept on hand.

At present time the Hallidie Machinery Company have under way power plant equipment for the following:

Steam plant at Wallace, Idaho for Wallace Light and Water Company, consisting of Murray Corliss engine, Geary water tube boilers, condensing plant with usual auxiliary equipment. The engineering work consists of a general remodeling of the old plant and installation of the new one.

At North Yakima, Wash., for the Northwest Light and Water Company, 1300 horsepower tandem compound McEwen engine arranged for direct connection 750 kilowatt, 3-phase dynamo running at 150 revolutions per minute. Geary water tube boilers, ultimate capacity 12,000 square feet of heating surface; 15-foot induced draft fan, spirojector condenser and usual auxiliary equipment.

Citizens' Electric Company at Port Townsend, Wash., tandem compound McEwen engine, direct connected to 100 kilowatt, 2-phase Stanley generator, Geary water tube boiler with Foster superheater, surface condensing plant with primary and auxiliary feed water heaters, and usual auxiliary equipment.

Skagit Improvement Company at Sedro Woolley, Wash., Murray Corliss engine and Geary water tube boiler, and usual auxiliary equipment.

Ritzville Electric Company, Ritzville, Wash., tandem compound McEwen engine, also single cylinder McEwen engine, high pressure boilers and auxiliary apparatus, together with all electrical equipment.

Jim Creek Water, Light and Power Company, Arlington, Wash., turbine water wheel equipment complete.

City of Bellingham, Wash., turbine water wheel equipment for municipal lighting plant complete.

The Company has found it necessary to increase their force at Spokane branch office by the addition of an engineer to look after the extensive engineering work in that vicinity. They are making a specialty of irrigation work, installing pumping and power plants, which require the need of an engineer of ability to handle same, and are now prepared to do this work in all its details, from designing plant to furnishing the complete equipment. This is in addition to the force of engineers in the Seattle office.

ASBESTOS PACKINGS.

The tendency of modern steam plants to use higher steam pressures than heretofore has called for a better class of steam packings than has hitherto been necessary. The use of packings made of rubber or organic materials is not advisable, as such packings will not satisfactorily withstand the high pressures and high temperatures to which they are subjected.

Packings made of asbestos fibre, on the other hand, have been found to meet all requirements of this service. The well-known firm of H. W. Johns-Manville Co. has achieved great success with their line of "J-M" asbestos packings, as these are thoroughly reliable and are made in various forms to meet every requirement and condition. These packings possess the highest heat-resisting properties, are extremely durable, and do not harden or blow out under the most severe conditions. No rubber or organic materials are used in their make-up and they will withstand any degree of temperature or pressure, are extremely pliable and will readily conform to irregular surfaces. The H. W. Johns-Manville Co., New York, will shortly issue an attractive catalogue showing their complete line of "J-M" asbestos packings, and we understand that copies of this will be mailed free upon request.

TWO NOTABLE SALES OF GAS ENGINES AND GENERATORS MADE BY ALLIS-CHALMERS CO., INCLUDING ANOTHER MILLION DOLLAR ORDER.

The Carnegie Steel Company has purchased for its Homested Works two 2,000 K.W. alternating current generators, driven by gas engines. These units are to be furnished by the Allis-Chalmers Company of Milwaukee, and they complete an order recently given for machinery costing approximately one million dollars, to be built by Allis-Chalmers Co. for the Homestead plant. It includes three gas-engine-driven electric units and four gas-blowing engines, the aggregate capacity of these machines being nearly 30,000 H. P.

This follows close upon the recent million dollar order given to Allis-Chalmers Co. by the Indiana Steel Co. for the electrical equipment of its new plant at Gary, Ind., where gas engines of the same type and capacities, operating on waste gas from the blast furnaces, are to serve as prime movers for electric generators supplying current to the steel mills. Other purchases of gas-blowing engines and gas-engine-driven electrical units made from the Allis-Chalmers Co., amount to practically a million dollars more; so that sales during the past few months have aggregated three million dollars.

Now another notable sale of gas-engine-driven electrical generating units has just been made to the Milwaukee Northern (electric) Railway Co., whose plant will represent the largest installation of this kind on the continent. The power house of this company, which will be situated at Port Washington, Wis., is to contain three horizontal twin-tandem gas engines, each having a rated capacity of 1,500 H. P., with liberal allowance for overload, direct-connected to three 1,000 K.W. 3-phase 25-cycle alternating current generators. The complete units will be built and installed by Allis-Chalmers Co. The exciting units for these generators, which are to be driven by special vertical gas engines, will also be furnshed by Allis-Chalmers Co. All of the engines are to operate on producer gas.

This order was placed only after a very thorough investigation made in behalf of the Milwaukee Northern Railway, and has been decided on the ground of "economy," as shown by gas engines of the type which Allis-Chalmers Co. is building.

Kingman, Ariz.—The Desert Power Company is preparing to erect a power plant in Kingman. The company has been organized with a capital stock of $10,000.

News Notes.

WASHINGTON NEWS NOTES.

(From Our Special Correspondent.)

Spokane, Wash.—H. W. Kent of Vancouver, secretary of the British Columbia Telephone Company, Ltd., who is in Spokane for a few days, announces that the central offices at Greenwood and Grand Forks will be rebuilt at a cost of $25,000, also that the company will extend a line direct from the boundary to Rossland, thus eliminating the detour into the State of Washington by way of Bossburg and Northport, as at present.

Not satisfied with the prices charged by the through lines, the Farmers' Mutual Telephone Company has been organized at Granger, Wash., with a capital of $50,000, and it is announced that connections will be made with the Spokane Home Telephone Company's lines. Work is to begin in two weeks.

The Kerr-Gifford Grain Company is installing a line from Walla Walla to Spofford, south of Spokane, and it is announced that four other farmer lines are building into the first-named city to make connections with the Pacific States system, which has also just taken over the rural lines at Milton, Wash., where a night service is to be added.

Farmers at Rock Island, west of Spokane, are organizing a mutual company to run a telephone line from that city to Wenatchee and to Badger Mountain, connecting also with Waterville, giving it connection with every town in the Wenatchee valley. It is purposed to extend the line into the Big Bend country before the end of the year.

Negotiations are making by the completion of which the Pacific States Telephone Company will gain control of all the territory in the Palouse country, south of Spokane. The company has made offers in various towns in the district to cut the present rate of $18 a year to $1 and put in the instruments at actual cost.

Three million dollars is the extent of the trust deed filed in Spokane county by the Home Telephone & Telegraph Company of Spokane in favor of the Title Insurance & Trust Company of Los Angeles, Cal., the document being signed by Charles E. Sumner, president. It covers in blanket all the real and personal property, franchises, lines and extensions owned by the company. The company has bought a site for $25,000 in the business district, and it is announced a $60,000 office building will be erected the coming fall. The company will operate the automatic system, for which it has already signed 5000 contracts in Spokane.

Official announcement is made by Charles W. Reynolds, manager of the Spokane division of the Pacific States Telephone & Telegraph Company, that $500,000 will be expended on its system in the improvements now under way. New instruments are to be installed and the distributing frames will be replaced with apparatus of the newest design, the cost of the latter being $66,000. The company recently completed the installation of 1500 telephone instruments, connecting the ranchers and farmers in the Spokane district with the central office in this city.

Spokane capitalists, headed by David T. Ham, are planning to build an electric line from Big Falls, Wash., along the Pend d'Oreille river into the mining and timber country north of Newport, 31 miles, and to secure the necessary power it is purposed to harness the river near Box Canyon. Congress passed a bill by Congressman Jones permitting the company to build a dam near Box Canyon, also to build a line across the stream. Work is to begin early the coming year.

Professor S. H. Sauve of Spokane, who has been five years in the employ of the Pacific States Telephone & Telegraph Company, has perfected an electrical device, which, he declares, will greatly increase the efficiency of long-distance lines, and will apply wherever induction coils are used. He struck upon the plan while experimenting with a coil in which one wire was broken. He uses three wires in the new coil and he says this increases the efficiency by 40 per cent. He has been placed at the head of a company having a capital of $750,000, and a plant will be established in Spokane the coming fall. The device is protected by patents in the United States and foreign countries.

Negotiations have just been completed by which the Home Telephone Company of Spokane will have long-distance connections with every independent telephone company in Washington and Idaho. It also has a contract with the Puget Sound Telephone Company, which has connections with every independent line in the Sound country. These towns in the Spokane district have been added to the automatic system: Pullman, Garfield, Oakesdale, Waverly, Mount Hope, Kendrick and Rockford, Wash., and Moscow, St. Joe, Harrison, St. Maries, Sandpoint, Post Falls, Coeur d'Alene, Wallace, Wardner and Osburn, Idaho.

Jay P. Graves, president of the Inland Empire Electric Railway Company, whose bonds to the extent of $30,000,000 were recently underwritten by E. H. Rollins & Sons of Boston, and Peabody, Houghtaling & Co. of Chicago, announces that the line of the Spokane & Inland Railway will be extended from either Moscow, Idaho, or Palouse, Wash., to the Snake river, with a view to making Lewiston, Idaho, giving the road 150 miles of line. The new line between Spokane and Lewiston will be 35 miles shorter than the Northern Pacific line between the two points. Work is to begin the coming fall. F. A. Blackwell, chairman of the finance committee, also announces that a line from Spokane to Lake Pend d'Oreille, Idaho, 56 miles, will be in operation in a year. This line is in opposition to the projected railway by the Spokane-Lake Pend d'Oreille Rapid Transit Company, of which C. H. Reeves, one of the original owners of the famous Hercules mine, is president. The last-named company has run its surveys, secured right of way and terminal grounds in Spokane and at Squaw Bay, Idaho. The outcome of the fight for supremacy is being watched with interest by railway men in the Pacific Northwest, as both concerns claim title to the lake property.

Announcement is made that the Hayden Lake branch of the Coeur d'Alene & Spokane line, between Coeur d'Alene and Hayden lake, will be in operation early in September. The line is seven miles in length and will eventually be extended to the northeast to tap the mining and timber regions.

W. H. Plummer, president of the Spokane & Big Bend Electric Railway Company, is authority for the statement that the line between Spokane and Davenport, Wash., will be in operation before June, 1907. Surveys have been completed and 75 per cent of the 120 miles of right of way has been secured, and it is stated that work will begin some time this month.

The Colville & Columbia River Railway & River Transportation Company has been incorporated in Spokane, with a capital of $250,000, and will build 19 miles of line between Colville and Myers Falls, Wash., making steamship connections on the Columbia River. The incorporators are A. Wilkes, W. B. Aris, Ellen C. Gilluly, G. K. Gilluly and H. C. Rice, all of Spokane, where the head office is located. The line will cross the south half of the Colville Indian reservation.

FINANCIAL.

Alameda, Cal.—The annual report of Superintendent Kahn of the municipal electric light plant shows total earnings for the year of $74,746, an increase of $10,250.45 over the total earnings of last year. The operating expenses were $36,455.11. The plant is to be enlarged immediately by the addition of some $15,000 worth of new machinery, part of which has already arrived. The non-arrival of the new $8000 engine is causing some anxiety. It was shipped from the East several months ago.

San Francisco.—The Associated Oil Company some months ago acquired the Matson plant, for which the company incurred a debt of about $750,000. The company had decided to issue bonds with which to pay for the plant. Fully $200,000 of the bonds had been underwritten when the great fire of April disturbed the financial market and the bonds were withdrawn from the market. The directors are now considering the advisability of passing the dividends to the amount of about $500,000 and of applying that money to the payment of the Matson plant. The company has been paying 3 cents a share annual dividend on its 22,828,300 shares, payments being made semi-annually.

San Francisco.—W. W. Hanscom, formerly of the Union Iron Works, has taken the position of general superintendent of the Century Electric Construction Company. H. S. Tittle is no longer with the company.

San Francisco.—A meeting of the stockholders of the Arline Oil Company will be held on August 19th for the purpose of electing officers and the transaction of such other business as may be brought before the meeting.

San Francisco.—An assessment of 2 cents per share was levied July 13th on the capital stock of the Santa Lucia Oil Company, payable on August 18th, delinquent August 18th; sale date, September 8th.

INCORPORATIONS.

Ventura, Cal.—The Ventura County Power Company has been incorporated at this place with a capital stock of $2,500,000 by C. H. McKevett of Santa Paula, J. A. Driffill of Oxnard, and J. E. Adams, T. W. Phillipps, J. S. Torrance, J. R. Martin and W. R. States of Los Angeles and Pasadena.

San Francisco.—The Standard Electric Construction Company has been incorporated with a capital stock of $10,000 by Nathan Fallek, F. G. Shrewsburg, Andrew Smith, Anna Van Maren and E. W. Levy.

San Francisco.—The Coachella Land and Water Company has filed certified copy of articles.

San Francisco.—The Standard Electrical Works has been incorporated with a capital stock of $100,000 by R. J. Davis, Harrison Dibblee, A. M. Funke, A. S. Armstrong and H. C. Thaxter.

San Francisco.—The Three Counties Oil Company has filed certified copies of articles with a capital stock of $1,000,000. The incorporators are A. W. Linforth, F. J. Griffin, R. A. Morton, Le Roy Moore, D. H. Foote.

San Francisco.—The Martinez and Contra Costa County Railway Company has been incorporated with a capital stock of $10,000 by Purcell Rowe, M. R. Jones, W. A. Golschard, Carl A. Johnson and A. H. Flynn.

San Francisco.—The Electric Railway and Manufacturers' Supply Company has been incorporated with a capital stock of $50,000 by A. St. J. Bonie, S. H. Taylor, Frank Frisbee, H. P. Bowie, H. S. Hagan.

Los Angeles, Cal.—The Pasadena Gas Appliance Company has been incorporated with a capital stock of $10,000 by W. B. Gard, C. W. Franklin, F. E. Culver, W. L. Jones and F. B. Culver.

TRANSMISSION.

Yuma, Ariz.—A contract has been closed whereby the Russell Electric & Machine Company will extend the electric power to the foot of the Tucson mountains and install a 30-horsepower electric motor.

Kalispell, Mont.—W. N. Noffsinger and Fred Tinkle have left for Chicago, where it is understood an important conference will be had with the chief stockholders of the Kalispell Water & Electric Company. It is generally believed the Bigfork Company is determined to take advantage of its franchise for light and power in the city and that it will extend its service.

TELEPHONES AND TELEGRAPHS.

San Francisco.—E. C. Bradley, formerly third vice-president of the Postal Telegraph Company, has been visiting in San Francisco. He has been spoken of as the successor of Henry T. Scott of the Pacific States Telephone Company, but says that there is no foundation for the rumor.

Jamestown, Cal.—Ralph Manning, electrician, has a force of men at work building a new telephone line from Jere to Middle Camp for the Sugar Pine Railway Company.

ILLUMINATION.

Healdsburg, Cal.—The residents of Alexander Valley have met with the City Trustees to formulate plans whereby the residents of that valley may be allowed to tap the electric lines to furnish lights for their homes.

Los Angeles, Cal.—Eleven bids have been received for the electrical equipment for the proposed municipal lighting plant. The bids were opened and referred to the Mayor and Expert Gass for tabulation and report.

Elsinore, Cal.—Dr. T. E. Ellis is erecting a building for the electric light and power house at the corner of Bath and Spring streets. The building will be ready for the machinery in about three weeks.

Covina, Cal.—An application has been made to the Board of Trustees for a franchise for an electric light, power and heating plant. Sealed bids will be received for the franchise by the Board of Trustees up to August 28th, 1906, the successful bidder filing a bond for $1000.

OIL.

Bakersfield, Cal.—The property of the Superior Oil Company, in the Sunset field, has been leased to the Adeline Oil Company. An official inspection showed all wells flowing in a satisfactory manner.

Gilroy, Cal.—Local stockholders in the new Moody Gulch Oil Company at Alma are much encouraged by the prospects. The company is down about 700 feet and is in oil sand, the oil being at the depth of 100 feet in the hole. Mr. Snyder, who is drilling the well, was in Gilroy last week and has made a most encouraging report to the balance of the stockholders. A company drilling on the opposite side of the gulch has recently struck a fine flow of paraffine oil.

Honolulu, T. H.—The Union Oil Company is to compete with the Standard Oil Company in the Hawaiian Islands. By the steamship Californian, from San Francisco, there recently arrived 4,000 cases of kerosene from the refinery of the Union Company in California. This is the first attempt ever made to compete with the Standard Oil Company in these islands.

Bakersfield, Cal.—The famine in oil cars still continues and is daily growing worse. The railroads frankly tell the producers they cannot furnish cars, though it is a fact that production in the county was never as low as it is now. The small producer who is trying to sell his oil independently of the marketing concern, finds himself in a tight place.